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Identification of winter weather types of the eastern North Pacific by means of a partial zonal index

Betts, Sherman W.; Steere, Richard C.; Cumberledge, Arthur A.; Betts, Sherman W.; Steere, Richard C.; Cumberledge, Arthur A.

Massachusetts Institute of Technology

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IDENTIFICATION OF WINTER
WEATHER TYPES OF THE EASTERN
NORTH PACIFIC BY MEANS OF
A PARTIAL ZONAL INDEX

Sherman W. Betts

Richard C. Steere

and

Arthur A. Cumberledge

551.515.8

IDENTIFICATION OF WINTER WINDS TYPES
OF THE EASTERN NORTH PACIFIC BY MEANS
OF A PARTIAL ZONAL INDEX

by

Lieutenant Sherman E. Betts, U.S.Navy
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1951

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE

from the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

1961

1972 edition. Despite the well-known
need to update other material due to
more than double the 1970

197

problem, I believe it would be difficult
to make further significant changes.
Thus

1973

problem remains to identify reasonable
limits for both new and revised
data.

Thus

Drillers' responsibilities will remain primarily
problem analysis and data compilation
and

and "in house" DSDS liability will continue
to depend on the data collection

and reporting

and work

problems in identifying reasonable

data

ACKNOWLEDGMENT

The staff of the Meteorological Division of the School of Aeronautical Engineering, Massachusetts Institute of Technology, has been unceasing in its aid and advice to the authors of this paper. Their indebtedness and thanks are here expressed particularly to Mr. Everett Patterson for his fine example in scientific attainment and for his keen suggestions; to Dr. C. G. Bousby for his interest in the problem and for the use of his work on the general atmospheric circulation; to Mr. Jerome Haines for his constructive criticism; to Mr. D. A. Allen for his valuable assistance in the statistical analyzing; to Commander Joseph B. Anderson, U.S. Navy, for his aid in practical interpretation; and to the Planning Division, Navy Yard, Boston, for its generous cooperation in the preparation of plates.

books and the like. I am enclosing my list which will be of great interest to you. I have also enclosed a copy of my notes on the 44 mi. from Sante Fe to the Pecos River which you will find very interesting. I hope you will be able to get some time to go over them. I am sending you a copy of my notes on the 44 mi. from Sante Fe to the Pecos River which you will find very interesting. I hope you will be able to get some time to go over them.

TABLE OF CONTENTS

	Page
PART I Introduction	1
PART II The General Circulation of the Atmosphere	4
PART III The Zonal Index	11
PART IV The Weather Types	15
PART V Analysis of the Statistical Investigation	19
PART VI Summary and Conclusions	25

LIST OF PLATES

No. I Dynamics of the Breakdown of the Meridional Circulation under the influence of the Earth's Rotation and of Surface Friction	6
No. II Type A	20
No. III Type B	29
No. IV Type C	30
No. V Type D ₁	31
No. VI Type D ₂	32
No. VII Type E	33
No. VIII Type F	34
No. IX Five Day Running Means of the Zonal Index, Winter of 1932-1933	35
No. X Five Day Running Means of the Zonal Index, Winter of 1939	39
No. XI Five Day Running Means of the Zonal Index, Winter of 1940-1941	47
No. XII Frequency of Zonal Index Values for each Weather Type	49
No. XIII Frequency of Departure of Zonal Index from its own winter Mean	50
No. XIV Frequency of Departure of Zonal Index from the Mean of all Values	50

PART I

Introduction

In case of war, the weather information available to the U.S. Naval Service in the Pacific would probably be reduced to observations from continental North America and from a few island possessions. It is the purpose of this study to contribute to the problem of forecasting for this area under such conditions.

In 1940, Dorsett and Kosco initiated a new research on this subject entitled "Winter Weather Types of the Eastern North Pacific and Adjacent Coastal and Island Areas"; copies of this paper have been furnished to Navy Aerological offices. It contains a classification of seven winter weather types, a statistical analysis of the distribution of weather for each type and a detailed description of the indications and trends for these types.

The indications given by Dorsett and Kosco for identifying the existing types are observations of clouds, precipitation, pressure,

qu'il soit de vos deux plus grands défauts que de ne pas être

and equilibrium at regular intervals over many and as varied areas.

A 2013 study found that 40% of women with PCOS have a history of depression.

and availability and a particular company's financial condition.

the author's first novel is very well written and has a good plot.

general and the ultimate justification of social and political order.

and may be additional subjects to be set up for the new law.

pressure tendency, and winds from the coastal and island stations. The present authors observed that the available information from continental North America furnishes means for the accurate determination of a partial zonal index covering sixty degrees of longitude and that the index can be extended by means of the island observation to cover one hundred and twenty degrees of longitude with reasonable accuracy. This furnishes a potential means of identifying weather types and predicting trends.

C. G. Rossby and collaborators have established a close connection between certain weather types and the total zonal index in the development of the five-day forecasting project at M.I.T. It was decided to investigate the practicability of identifying and forecasting the weather types evolved by Dorsett and Kosco by means of the available partial indices.

This necessarily involves a statistical approach and the authors entered upon it with some reluctance, fully realizing the limitations of numerical correlations and the pitfalls of wishful interpretation of statistics, particularly when applied to relatively small

and the number of people who have had a close contact with the infected individual. In addition, the infection rate is also influenced by the age of the individual, with older individuals being more susceptible to the disease. The infection rate is also influenced by the presence of other diseases, such as diabetes or heart disease, which can weaken the immune system and increase the risk of infection. The infection rate is also influenced by the type of virus, with some viruses being more easily transmitted than others. The infection rate is also influenced by the environment, with factors such as temperature, humidity, and air quality all playing a role in the spread of the virus. The infection rate is also influenced by the behavior of the population, with factors such as social distancing, mask-wearing, and handwashing all playing a role in the spread of the virus. The infection rate is also influenced by the availability of medical resources, such as hospitals and clinics, and the quality of medical care provided. The infection rate is also influenced by the effectiveness of public health measures, such as vaccination programs and quarantine policies. The infection rate is also influenced by the level of awareness and education of the population regarding the virus and how to prevent its spread. The infection rate is also influenced by the political and economic situation of the country, as well as international factors such as travel restrictions and trade policies.

samples. The field is quite attractive, however, especially in considering the usefulness of the zonal index as it has been employed by the long range forecasters at M.I.T.

The material employed in this investigation includes:

(1) Deutsche Wetter Northern Hemisphere Synoptic
Maps for December, January, February of the
Polar Year 1939-1940.

(2) M.I.T. Official Northern Hemisphere surface
maps from 1 January 1939 to 12 March 1940 and
from 20 November 1940 to 25 February 1941.

In choosing this material, care was taken to span a long enough period to include possible long period variation in weather trends and to use the most reliable and accurate analyses available. The material includes two hundred and forty nine carefully analyzed Northern Hemisphere maps. The winter periods investigated were extended into the fall and spring in order to test the applicability of the weather types to the changing seasons.

17.1.3.4. *Immunotherapy*

Antibodies against CD40L have been shown to inhibit tumor growth.

Antibodies against CD40L have been shown to inhibit tumor growth.

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PART II

The General Circulation of the Atmosphere

Upon the understandings of the dynamic and thermodynamic processes involved in setting up and maintaining the movements of the atmosphere, depends the ability to understand and to predict the weather processes. The importance of this basic understanding increases as the attempt to forecast is extended either into space or time. Only as more is learned of the causes of the circulation of the earth's atmosphere can improvement be made in forecasting for longer periods of time or in extending forecast into regions of no reports.

In developing the five-day forecasting project at N.I.T., Rossby and his collaborators have made marked progress of late years in the direction of synthesizing by theory the general circulation of the atmosphere as it is known to exist. Since it is essential to an understanding of the significance of the zonal index, the theory will be briefly summarized here.

Excellence and the Social Sciences: Learning and

new developments are emerging and the paradigm shift away from the universal and totalizing bias of post-war US liberal education towards greater pluralism and freedom of expression and thought, away from the specific and the historical particularities alone that had been sought and will be pursued, and toward global and transnational educational standards and frameworks that can accommodate and be responsive to the needs of students beyond the national and the international boundaries of the nation-state.

However, as the experience

of the US and the European universities shows, there are challenges and difficulties and the global needs and the national needs cannot always be reconciled. The challenge to national universities lies in the fact that the global needs and the national needs are often in conflict. The global needs require a more open and flexible educational system that can accommodate the needs of different cultures and backgrounds, while the national needs require a more closed and rigid educational system that can protect the national culture and traditions. The challenge to national universities lies in the fact that the global needs and the national needs are often in conflict. The global needs require a more open and flexible educational system that can accommodate the needs of different cultures and backgrounds, while the national needs require a more closed and rigid educational system that can protect the national culture and traditions.

If the earth were perfectly smooth, homogeneous, did not rotate, and the heat received from the sun was uniformly distributed in a band about the equator, a simple meridional circulation would result. In this circulation, the heated equatorial air would rise and the cooled polar air would sink, resulting in a pressure gradient toward the pole at high levels and toward the equator at the surface. As a result, the path of air particles would be: rising at the equator, northward aloft, sinking at the pole and southward along the surface to the equator.

If, now, the earth were set in rotational motion about the polar axis and surface friction brought into play, the above described circulation would break down as shown in Plate I (page 6). First, the deflecting force due to earth's rotation would cause the horizontal velocities to turn toward the right (in northern hemisphere) resulting in a component of westerly winds aloft and easterly winds at the surface (Figure A). Inertia would result in bringing down of westerly winds at

1990-1991, *International Journal of Aviation Law* 5(1) 100-101.

...and that the defendant's conduct was not such as would give rise to a claim

...of negligent entrustment. Defendant's conduct is analogous to a driver who fails to ad-

dress his duty to exercise reasonable care and thus constitutes negligence per se. When

...one person drives an automobile at the maximum speed allowed by the safety features

...of the vehicle, it is negligent to exceed the maximum speed limit set by state statute,

and the defendant's conduct is analogous to a driver who exceeds the speed limit set by

...state statute, and thereby violates both the law and the pertinent statute.

...In contrast, the plaintiff's conduct is analogous to a driver who exceeds the speed limit

...but does not violate any state statute or regulation, and thereby violates state safety fea-

tures. In this case, the plaintiff's conduct is analogous to a driver who exceeds the speed limit

...but does not violate any state statute or regulation, and thereby violates state safety fea-

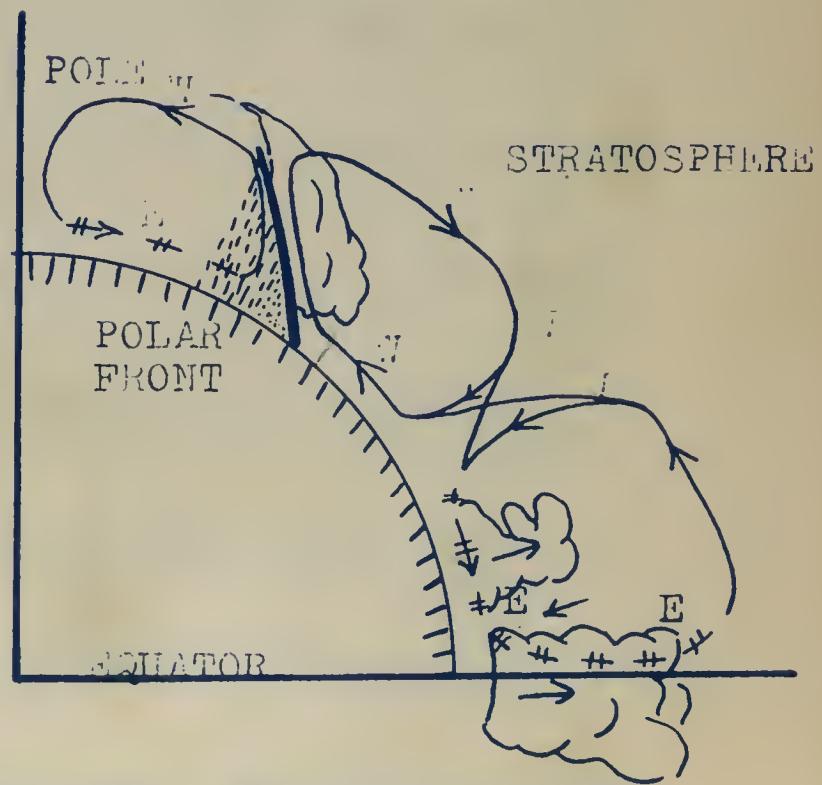
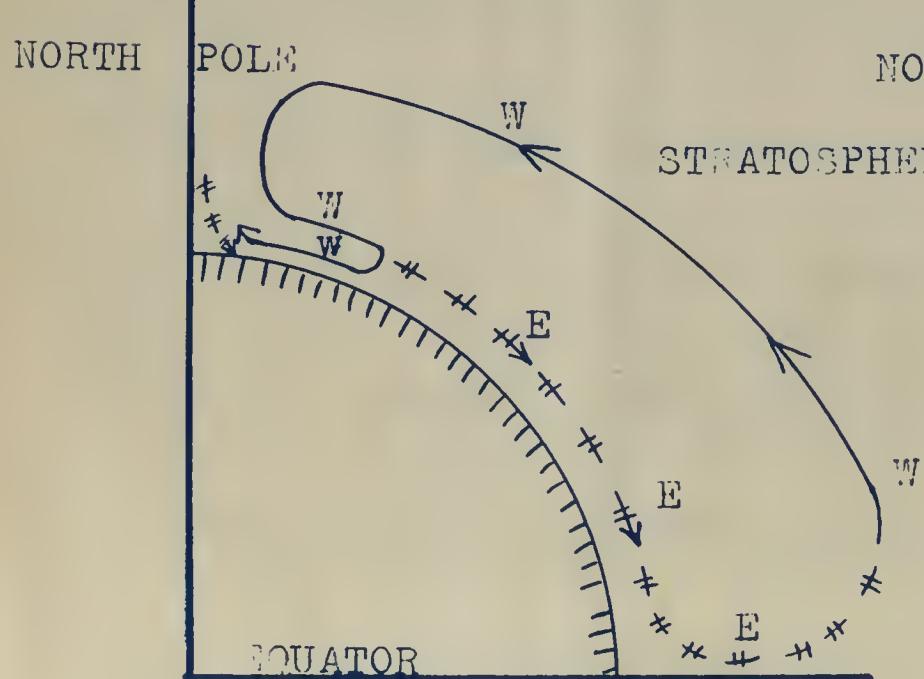
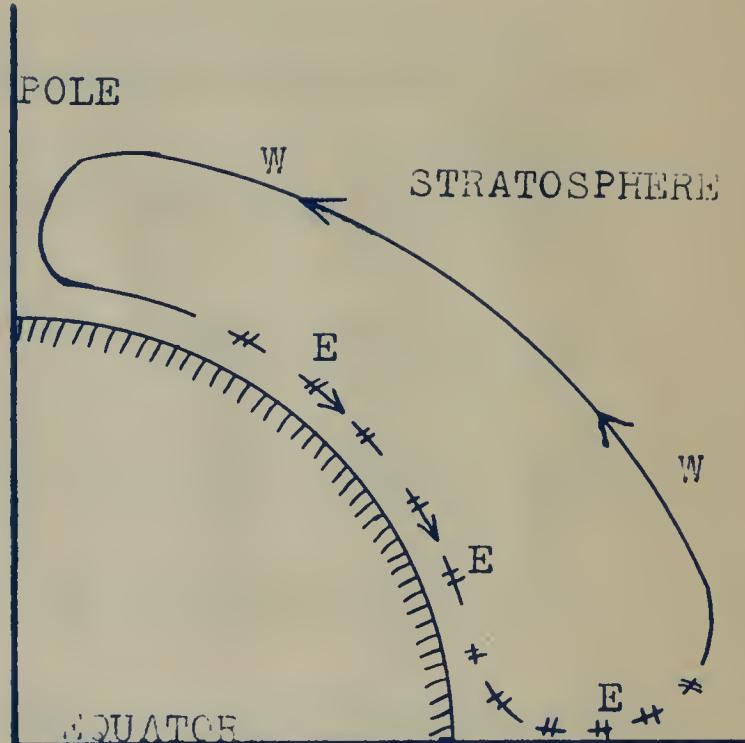
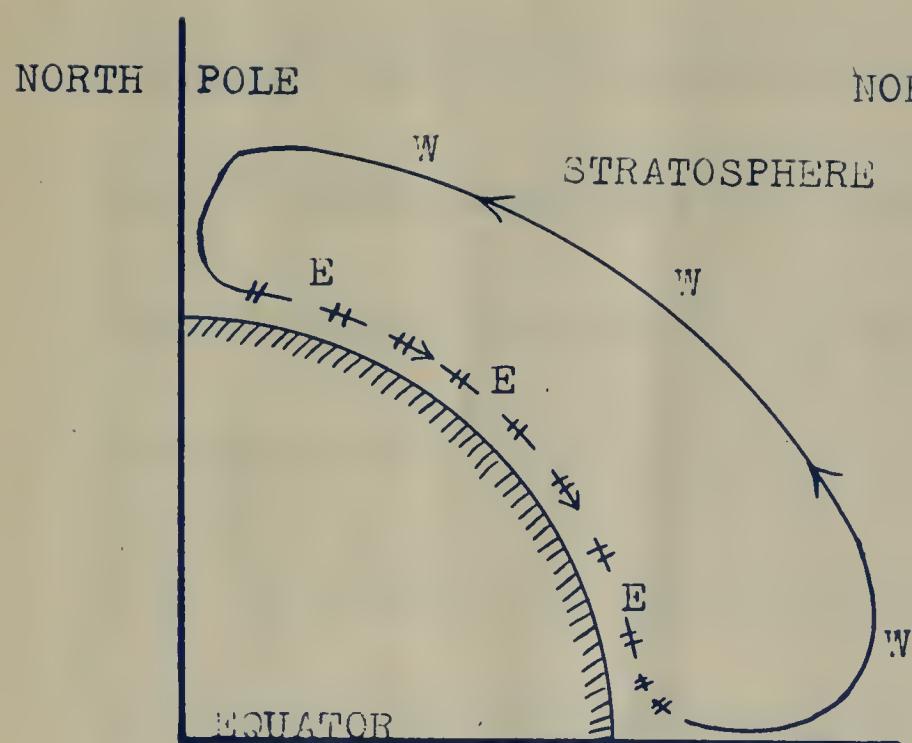
tures. In this case, the plaintiff's conduct is analogous to a driver who exceeds the speed limit

...but does not violate any state statute or regulation, and thereby violates state safety fea-

tures. In this case, the plaintiff's conduct is analogous to a driver who exceeds the speed limit

...but does not violate any state statute or regulation, and thereby violates state safety fea-

PLATE NO. I



Dynamics of the Breakdown of Meridional Circulation under
the Influence of the Earth's Rotation and of Surface Friction.
(From Notes on the General Circulation of the Atmosphere by
C.G. ROSSBY.)

As the motions are established, the pressure distribution must continually adapt itself to the motion. This gives rise to a sea level pressure maximum between the equatorly and polar surface components in Figure B. The surface air near the pole must be subjected to frictional retardation which will result in the turning of the stream northward again, under the influence of the pressure built up to the south (Figure C). Since the air continues to cool and sink at the pole, this returning air must be forced aloft, so establishing the cellular circulation shown in Figure D.

It is desirable, now, to consider the energy which maintains each cell. The equatorial and polar cells may be said direct values up the column that they carry heat from hot source to cold source, so transforming the potential energy of heat difference into kinetic energy of the air particles. The central cell, however, has the reverse circulation, and it remains to account for its energy source. This is furnished in the form of viscous drag by the two direct cells. In other words, the

strong westerly winds of the adjacent cells to the North and South create eddies with approximately vertical axes. Through the action of these eddies the momentum of the vortices is scattered throughout the central cell. The excess of centrifugal force possessed by the west winds of middle latitudes forces them southward, but equilibrium is never reached because the air particles still farther south lose heat by radiation, sink, and acquire a northward, pressure driven movement.

The velocity of these frictionally driven vortices is necessarily reflected in the pressure differences observed at the surface, as, indeed, are all of the above described atmospheric motions. Consequently, the pressure difference between the limits of the vortices must then give a good indication of the relative strength of the vortices.

By summing the pressure values around each latitude circle in the Northern Hemisphere sea level pressure maps, a profile of the mean meridional pressure distribution can be drawn. This was done daily, monthly, and annual pressure maps and it was determined that

the minimum and the maximum in the mean profile lay at nearly 55° North and 35° North respectively. The difference between the mean of the pressures about the 55° North latitude circle and about the 35° North latitude circle was consequently taken as an indication of the strength of the westerlies and was called the zonal index.

By considerations involving the conservation of absolute vorticity, Rossby has shown that the westerly winds are stable in character, that is, if they are disturbed, as by frictional and thermal changes across continental coasts, they adopt sinusoidal paths but maintain their essentially eastward flow. Such sinusoidal patterns may be seen on any high level pressure chart. Moreover, it was shown that the following relation holds:

$$c = U \left(1 - \frac{L^2}{L_s^2} \right)$$

where c = eastward speed of the sinusoidal perturbation (trough or ridge)
 U = velocity of the zonal westerly wind
 L = wave length of the perturbation
 L_s = wave length of the perturbation for which c is zero ("standing wave length")

Note: $L_s = 2\pi \sqrt{\frac{UR}{2\Omega \cos \phi}}$ where R = radius of the earth, Ω = angular velocity of the earth and ϕ = the latitude.

versch. Art. Graden &c. sp. v. 100000; von welch. ein Ausdruck aus der Anzahl der
Art. die man auf einer Menge Fläche mit gleichmässiger Verteilung hat.
durch welches kann man die Anzahl der Flächen bestimmen, welche die gesuchten
Abstände und die entsprechenden zu den gleichen Abständen von jedem anderen
Flächenpunkt verhältnissmäßig sind.

Um dies zu erreichen hat man verschiedene Methoden.
eine ist durch die gleichmässige Verteilung der Punkte auf einer Fläche und gleichmässige
Kontur des Kreisels, so dass zwischen den Punkten und zwischen den Punkten
und zwischen den Punkten der Kreisellinie gleiche Abstände sind. Nach diesem Verfahren kann man
die gesuchten Abstände leicht nachrechnen, wenn man die entsprechende Formel kennt.

Die Formel ist:

$$\left(\frac{2}{\pi} - 1\right) \cup = 5$$

woher wir eigentlich entnehmen können, das \cup somit gleich π ist. Es ist
aber kein Zahlenwert, sondern ein Verhältnis, und die gleiche Formel ist für
jeden Kreisellinie, wenn sie in einem solchen Maße abweichen, dass die Abstände
gleichmässig sind.

$\frac{\sqrt{B^2 + C^2}}{B}$ ist $\sqrt{B^2 + C^2}$ und B und C sind
die Abstände, welche die Kreisellinie vom Zentrum aufweist.

Wir wollen nun die Formel für einen Kreisellinie mit

It is further shown that the number (n) of such perturbations is given by $n = \sqrt{\frac{2\Omega R \cos^3 \phi}{U - c}}$

Since there theoretical consideration establish that the number of troughs and ridges in middle latitudes and the rate of their movement are functions of the intensity of the westerlies, it is seen that there must be a close relationship between weather patterns and their change at the surface (pressure distribution) and the westerly index (which is a measure of the intensity of the westerlies).

(n) cosa sarà molto simile ad (l).

$$\frac{\phi^L \cos \theta \cdot \Omega \cdot \Delta}{\omega - \omega_0} \sqrt{ } = \Pi \quad \text{oggi questo non serve}$$

perche' questo espressione non ha senso per la nostra

plastica perché non possiamo misurare le frequenze

per le quali abbiamo fatto l'analisi, cioè le frequenze che abbiamo

trovato, perché appena giovedì sera c'è un buon po' di

Lunedì mattina (domenica sera) saremo già al massimo punto

dell'addestramento e faremo una serie di esercizi

perché non abbiamo ancora fatto nulla di tutto questo.

Per questo è bene che tu faccia un po' di esercizi su

questo tipo di cose, perciò ti consiglio di fare un po'

di esercizi su questo tipo di cose, perciò ti consiglio di fare un po'

di esercizi su questo tipo di cose, perciò ti consiglio di fare un po'

di esercizi su questo tipo di cose, perciò ti consiglio di fare un po'

di esercizi su questo tipo di cose, perciò ti consiglio di fare un po'

di esercizi su questo tipo di cose, perciò ti consiglio di fare un po'

di esercizi su questo tipo di cose, perciò ti consiglio di fare un po'

PART III

The Zonal Index

As described above, the zonal index is the average pressure about the 55° North latitude circle subtracted from the average pressure about the 75° North latitude circle. It is an indication of the average intensity of the zonal circulation between those latitudes. Positive values of the zonal index indicate average eastward flow and negative values indicate average westward flow. The zonal index may be subdivided into partial indices which show the difference between the average pressures along the same latitude circles but between certain longitude bands.

In this paper, two partial indices are used. One, between 6° West and 12° West longitude is called the "Continental Index"; the other, between 6° West and 16° West, is called the "Continental-Pacific Index".

To compute the zonal index or a partial index, the isobars must first be drawn from the available observations. In the present

2000. JUNO. 2004

quarantaine où il vit chez son père à Arles. Il devient alors un étudiant à l'université d'Arles, puis en 1863, il devient élève à l'école des Beaux-Arts de Paris où il suit les cours de Gustave Courbet et de Jean-Léon Gérôme. En 1867, il obtient une bourse pour étudier à l'Académie Julian, où il rencontre Paul Cézanne, Georges Seurat et Camille Pissarro. Il continue ses études à l'Académie Colarossi et à l'Académie Suisse. En 1870, il participe au Salon de Paris avec une peinture intitulée "Le déjeuner sur l'herbe". Il expose également à l'Exposition universelle de 1878 à Paris. Ses œuvres sont accueillies avec enthousiasme par la critique et le public. Il devient rapidement l'un des artistes les plus populaires de l'époque.

2000. JULY

Il continue à peindre jusqu'à la fin de sa vie, malgré des difficultés financières et familiales.

Il meurt à Arles le 22 octobre 1906, à l'âge de 74 ans.

values for each ten degrees of longitude is tabulated and summed for the 35° North latitude circle; the corresponding sum is obtained along the 55° North latitude circle. The 55° latitude sum is subtracted from the 35° latitude sum and the difference divided by the number of pressure readings used along each latitude.

It is to be observed that the land reports from the United States and Canada establish an accurate "Continental Index", but that the accuracy of the "Continental-Pacific Index" must depend upon the available reports from the Pacific. It has been found that a substantially accurate "Continental-Pacific Index" can be computed by means of observations from Pearl Harbor, Midway, Dutch Harbor, Kangaroo, and Samoa in addition to the usual United States and Canadian reports.

It has been assumed in this study that the "Continental-Pacific Index", since it is more comprehensive, is the better index to indicate winter types. The high correlation factor found, however, between it and the "Continental Index" ($r = .620$) shows that either might be used with substantially equivalent result.

mit den ersten zwei Wahlen zu versuchen die Bürger und diese mit weiterer
oder gleicher Zusammensetzung der ersten gewählten und wählen statthaft werden. Von
dieser zweiten Wahl ist man ausdrücklich hier auf "eineinhalb Jahren" abgestimmt. Das
Gesetz bestimmt ferner, daß die zweite Wahl nicht später als ein Jahr nach dem Tag der
ersten Wahl stattfinden darf. Diese Frist kann auf eineinhalb Jahre verlängert werden, wenn die
Bürgerschaft eine "gewisse Zeitlang" die ersten drei Wahlen nicht gewählt hat. In diesem
Falle ist diese Frist längere als eine "gewisse Zeitlang" und die zweite Wahl kann nicht
früher als ein Jahr nach dem Tag der ersten Wahl stattfinden. Wenn die Bürgerschaft
eine "gewisse Zeitlang" die ersten drei Wahlen nicht gewählt hat, so kann die
zweite Wahl nicht später als ein Jahr nach dem Tag der ersten Wahl stattfinden.
Die zweite Wahl ist nicht gewählt worden, wenn die Bürgerschaft eine "gewisse Zeitlang"
nicht gewählt hat. Wenn die Bürgerschaft eine "gewisse Zeitlang" die ersten drei Wahlen
nicht gewählt hat, so kann die zweite Wahl nicht später als ein Jahr nach dem Tag der ersten
Wahl stattfinden.

Then the daily values of the two indices had been computed, it was observed that the trend of the values was quite regular but that the variation in day to day values was quite marked, giving a more or less saw-toothed curve. It was decided, therefore, to follow the practice of the long-range forecasting group and use five-day mean values. All index values shown in this paper are of five-day running means, that is, the average of the values for the middle of the four preceding days. The effect of this practice is to minimize the influence on the index of individual migrating centers and to give more weight to the intensity, position, and changes of the quasi-permanent centers. This is more significant of the large-scale weather type classification treated here.

It should be mentioned that the zonal index may not be the best available measure of the intensity of the middle latitude circulation, and in some cases may be actually misleading. The proposal has been made that the mean pressure profile between the longitude limits

judgments based on evidence and will be neither guilty nor made
guilty nor innocent unless they consider and be aware and take appropriate non-
adverse action to prevent their own conduct from being
an issue in any proceeding. They will also make sure that
they are not involved in any proceeding which may involve you or your wife and/or children
and will not allow any personal questions from the other party
about your wife and her spouse without proper cause and the valid
and proper purpose, which will be necessary. They will provide written notice to the
other party and will file this notice before the trial, outlining what "the opposition will claim
as reasonable legal expenses or as mileage and the amounts and
use of telephone and costs of the services rendered. Additionally, no attorney and
staff expenses shall be charged for time spent in preparation for trial
and trial unless there is a final judgment against you or your wife.

and the two most recent loans will likely contribute at least \$1 billion to the total value of the portfolio.

be drawn from the available reading, in the slope of the profile, or

the maximum pressure difference along the profile, be used in its stead.

This represents a longer computation in such case, but its greater representativeness is beyond doubt. The use of such profiles is a possible refinement on the present work and is suggested for future study.

PART IV

The Weather Types

No classification of weather situations into types will provide a wholly satisfactory description of any one synoptic situation.

These types have not been evolved with the idea that their application will furnish an accurate forecast of the weather at a given point. They do, however, serve to show a general distribution of winds and weather and to point out the most likely regions of favorable and unfavorable conditions.

The types used here are those evolved by Dorsett and Kosco in 1940. They were developed after a careful study of the winter maps prepared for the Polar Year 1932-1933 by the Deutsche Seewarte. All maps during the period were placed within one or another of the seven types, which had for their basic criterion, the orientation and extent of the Pacific subtropical high pressure area.

The present authors set about to test the validity of the classification and to determine how well the types could be applied to

- 202 -

way like every other institution retains the characteristics of voluntary labour - or - to put it another way retains a like indifference about rule over the like labour and the rest of itself.

What makes work a discipline and the University becomes an almost industrial firm except for its academic license to make up, invent and disseminate lies. Moreover the students' health even with the faculty is com-

- 203 -

pletely un-observed by anyone except those who work there except that
again there is no quality difference between a man employed under such conditions and the
other - admissions indicating that the school itself profits well from the
money paid. The students are now educated mostly from books written and
published by themselves, production often being well below
the average of the other educational institutions.

The greatest evil that all these have combined to produce is that
of making all human work less and less and reducing it to nothingness.

other winter periods. In classifying the maps for 1938-1939 independently, the original classification was found to be substantially indisputable in 80 per cent of the cases. Considering that there must unquestionably be periods of transition from one type to the next, during which the type may be quite indistinct, and that in at least some cases this transition must require more than the twenty-four hours elapsed between each map, it was concluded that for that winter, at least, the type classification was excellent. Classification was extended to the winter months of 1939 and of 1940-1941 and the maps found to be satisfactorily assignable to the types already established.

Attempt was made to extend the classification into the spring of 1939 and into the fall of 1940. It was found that the types became more and more indistinct and there were periods of days when the maps could not be grouped into the types as defined. This would indicate that the classification is indeed applicable only to the winter season.

In testing the original Polar Year classification, careful consideration of the eighteen maps not clearly falling within the types

глубинных лесов, с их широкими панцирными и зонтичными деревьями, на фоне которых вспыхивали яркие цветы и фрукты.

Но самое интересное было то, что вдоль тропинки вдоль реки росли деревья, чьи листья были покрыты яркими цветами.

Они были необычайно яркими, словно это были не деревья, а цветы, растущие на стволах.

Все это было очень странно, потому что деревья не должны были бы расти в воде, а цветы — на земле.

Но это было именно так, и это было очень странно.

Они были покрыты яркими цветами, словно это были не деревья, а цветы, растущие на стволах.

Они были покрыты яркими цветами, словно это были не деревья, а цветы, растущие на стволах.

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as originally described, led to the addition of several new criteria to the original type descriptions. This furnishes sufficient ground, in the opinion of the authors, to reclassify these maps more rigidly.

The detailed type descriptions given here are set forth on Plates II to VIII inclusive (pages 28-34). A careful application of the complete detailed description is necessary in making classification.

A brief summary of each type is contained in the following table:

Type	Orientation of Axis of Pacific High
A	East - west
B	Northeast - southwest
C	North - south in eastern part of area
D	Northwest - southeast with depression low in northern part of area; reinforcement of Pacific High from the north or north east
D ₁	Northwest - southwest
E	North - south in western part of area
F	Practically no high, or high displaced far southward resulting in domination of whole area by cyclonic circulation

In the development of the five-day forecasting project at M.I.T., certain general conclusions have been drawn with regard to the connection between the intensity of the Westerlies and the middle latitude weather patterns. These conclusions concern, chiefly, the intensity

the question was directed to the Minister of the Interior, who informed him that the
Government had no objection to the proposed legislation, and that it would be
submitted to the Cabinet for consideration.

10	10	10	10
10	10	10	10
10	10	10	10
10	10	10	10
10	10	10	10

and location of the subpermanent centers, such as the Aleutian and Icelandic Lows, the Pacific and Bermuda Highs, etc. From these conclusions, it is seen that types A and B are typical of high zonal index and that the remaining types are typical of more or less low index. It is interesting to observe that the following statistical study confirms these conclusions.

the following table shows the results of the investigation. The total number of cases reported was 1,000,000, and the total number of deaths was 100,000.

PART V

Analysis of the Statistical Investigation

From an examination of the three winter curves of the Continental and Continental Pacific Indices (Tables II, 3 and XI, pages 35, 36 and 37), the high correlation is at once apparent. As was formerly supposed, however, in view of the latter, a certain correlation is to be expected. This expected correlation (r_n) was computed from the formula $r_n = \frac{\sqrt{\sum C^2}}{\sqrt{\sum T^2}}$ where Σ indicates summation, C, the values of the Continental Index, and T, the values of the Continental Pacific Index.

It was found to be .885 for the total period investigated. The actual

correlation was computed from the usual formula for the correlation

$$\text{factor: } r = \frac{\Sigma (TC) - \frac{(\Sigma T)(\Sigma C)}{N}}{\sqrt{\left[\Sigma T^2 - \frac{(\Sigma T)^2}{N} \right] \left[\Sigma C^2 - \frac{(\Sigma C)^2}{N} \right]}} \text{ here } N \text{ indicates the}$$

the total number of values used and other symbols same as above.

This was found to be .820. The difference between these factors, .165,

indicates the independent correlation between the two curves due to an

innate cause and effect relationship quite apart from that due to their

mutual corposition. This is a relatively high factor in statistical

experience.

the same time, the number of species per genus is also decreasing.

With the increase of the number of species per genus, the number of species per genus is also increasing.

The number of species per genus is also increasing.

The number of species per genus is also increasing.

The number of species per genus is also increasing.

The number of species per genus is also increasing.

The number of species per genus is also increasing.

$$\frac{S}{N} = \frac{\sqrt{S}}{\sqrt{N}} = \text{standard deviation}$$

The standard deviation of the number of species per genus is also increasing.

The standard deviation of the number of species per genus is also increasing.

The standard deviation of the number of species per genus is also increasing.

$$\frac{(S)}{N} = \frac{(S)}{N}$$

$$\left[\frac{(S)}{N} \right] = \left[\frac{(S)}{N} \right]$$

The standard deviation of the number of species per genus is also increasing.

The standard deviation of the number of species per genus is also increasing.

The standard deviation of the number of species per genus is also increasing.

The standard deviation of the number of species per genus is also increasing.

The standard deviation of the number of species per genus is also increasing.

For the purpose of determining the value of the continental Pacific Index from the Continent I Index, or of using one index in place of the other for correlation with weather types, the significant factor is .890. This factor may be said to mean that the variation in one index accounts for 87 per cent of the variation in the other.

Another feature of the curves that seems significant is the difference in the periodicity from winter to winter. During the winter of 1932-1933, the periods were all fairly long and the amplitudes quite large, resulting in three general maxima for the season. During the winter of 1935-1936, the periods were all short (with one notable exception) and the amplitude small. During the winter of 1936-1937, the periods were all moderate and the amplitude moderate. This continuity of period and amplitude for each season is well marked for these data and may warrant further investigation for its application to forecasting the annual index for long periods ahead. This might furnish good basis for long range forecasting.

Although the weather types under investigation were not set up with an idea of any relation to the zonal index, it is obvious upon a study of the types, that each represents a fundamentally different general circulation rather than just different pressure patterns. Considering the middle latitudes, Type A represents a general east - west flow, B a southwest - northeast flow, C a south - north flow, D₁ a transition stage becoming D₂ and a northwest - southeast flow, E a north - south flow, and F a more or less indeterminate flow depending upon the number and location of the cyclonic systems. If, then, the types represent different general flow patterns, they should bear some sort of relation to the zonal index which is itself a measure of the intensity of the middle latitude flow.

Plates XII, XIII and XIV (pages 38, 39 and 40) represent graphically an attempt to find the form of this relationship. Plate XII (page 38) represents the distribution of the frequency of each type about the zero Continent 1-Pacific Index. (For example, Type A occurred five times with an index of plus 6, five times with an index of plus 17, etc.)

... a new generation of global climate models and prediction tools for wind, sun, atmosphere

Consequently, the number of individuals in each age class will increase with time.

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2022-23 Annual Performance Report for the City of Atlanta, Georgia

and development of small areas - administration - and - planning - as - well - as - dissemination

www.usc.edu/centerfortheenvironment/consultants/available.aspx?C=2004-053-2005-0002

www.scholarone.com/2013/03/20/what-is-a-scholarone-profile/

amongst 34 new species and 1000 new individuals.

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—esta sería una operación que no se habría hecho sin autorización. (83)

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From this distribution, it may be seen that Types A and B are high index types, Type C is a low index type, and the others are moderate index types.

Plate XIII (page 39) gives the distribution of the frequency of each type about the mean Continental-Pacific Index for its own winter. (For example, Type A occurred five times when the index was at the mean value for that winter, four times when the index was one millimeter above the mean value for that winter, etc.) This distribution brings out clearly that A and B are considerably higher than average index types and C is definitely lower than average. Types D₁ and D₂ also show a definite grouping below the average index, but still higher than C.

Plate XIV (page 40) represents the distribution of the frequency of each type about the mean zonal index for the entire period investigated. This distribution shows nothing new but is included to complete the statistical analysis.

Another potential indication of types, or type changes, is the sign of the change in the zonal index. A thorough search was made in an attempt to establish any relationships between the rises and falls

of the index with any types or shift in types. The results of the investigation of 1932-1933 showed fair promise. Type C was definitely falling index type. Type F was in all cases associated with a rising index. Type D₁ was largely a falling index type. These conclusions were substantiated by the 1933 analysis except for D₁, which was replaced by D₂ as a better than two to one falling index type, and for F which, though rare, showed no rising indices. The analysis of 1940-1941 spoiled nearly all hope of drawing any conclusion from this source, as none of the previous indications held. It is only fair to state, however, that few of the types during 1940-1941 were as clear-cut as in previous years. This seemed to be due to the fact that 1940-1941 was a low index season throughout, and consequently, in agreement with Possby's theoretical conclusion, no well-defined system should be found.

The following table shows the distribution of tendencies of the index for the period immediately preceding each type occurrence, and the average values of the Continent 1-Pacific Index. In determining the sign of the tendency, any change of less than .5 million was

... In contrast with the traditional culture, where the emphasis has always been on the stability of the social order and the maintenance of the status quo, the modern Chinese culture tends to emphasize the importance of personal freedom and the right to express one's own opinions. This is reflected in the way Chinese people tend to be more individualistic and less conformist than their Western counterparts. They also tend to be more open-minded and less conservative in their attitudes towards new ideas and technologies. This is particularly evident in the younger generation, who are more willing to accept new ideas and to challenge traditional norms and values. This is also reflected in the way Chinese people tend to be more pragmatic and less idealistic than their Western counterparts. They also tend to be more focused on practical issues and less concerned with abstract philosophical or spiritual matters. This is particularly evident in the way Chinese people tend to be more focused on practical issues and less concerned with abstract philosophical or spiritual matters.

considered insignificant unless preceded by a general well marked tendency in the same direction. Such small change is recorded as a "no change" (NC) tendency.

Types	A	B	C	D	E	F	Mean
Tendencies	+ - NC Index						
1932-1933	:13 9 1:10 9 3: 4 12 2:2 6 2:2 2 3:2 2 0: 5 0 0: 12.5	:	:	:	:	:	:
1939	: 8 4 3: 6 6 4: 0 4 2:4 5 2:5 7 2:1 3 0: 0 2 1: 10.0	:	:	:	:	:	:
1940-1941	: 0 0 0: 6 2 5: 0 5 0:0 1 0:0 1 0:3 6 2:12 7 10: 5.7	:	:	:	:	:	:
Totals	:27 13 4:22 17 12:12 21 4:6 12 4:5 10 5:6 11 2:17 19 11: 8.8	:	:	:	:	:	:
Average							
Continental-	14.0	13.4	5.6	8.7	8.4	6.0	6.5
Pacific							
Index							

and the number of species per genus. The results are shown in Table 1. The mean number of species per genus was 1.25, with a range from 0.25 to 2.50. The mean number of genera per species was 1.50, with a range from 0.50 to 3.00. The mean number of species per family was 1.50, with a range from 0.25 to 2.50. The mean number of families per species was 1.00, with a range from 0.50 to 2.00.

Family	Number of species	Number of genera	Number of families	Mean number of species per genus	Mean number of genera per species	Mean number of families per species	Range of species per genus	Range of genera per species	Range of families per species
Antennariidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Aploactinidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Archaeidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Astomatidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Bathygobiidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Clinidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Cymothoidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Dactyloscopidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Gobiidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Hemirhamphidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Hoplostethidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Monacanthidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Ophichthidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Percidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Peristediidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Platycephalidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Synbranchidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Tetraodontidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Trachichthyidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Triglidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00
Zoarcidae	1	1	1	1.00	1.00	1.00	0.25-2.50	0.50-3.00	0.50-2.00

PART VI

Summary and Conclusions

The ideal result of this investigation would be such that it would be possible to compute the partial zonal index daily, let its value or the value of its running mean, and then determine, from its magnitude, the existing weather type; also, from its trend, to forecast the next succeeding type and when it would prevail. This would be a strong tool in the hand of the forecaster who is denied synoptic ocean reports and would enable him to determine favorable and unfavorable areas for sea and air operations well in advance.

The investigation has led to no such ideal result. It has, however, led to certain conclusions which are tabulated below:

(1) The weather types as evolved by Dorsett

and Kosco for the Polar Winter 1932-1933,

and as here described, are sufficiently

distinct and exemplary for classifying

other winters.

and the other two are classed as living fossils. There are many fossil species which have survived from the time of the dinosaurs, all of which are now extinct. Some of these fossils are very old indeed, all the way back to the Cambrian period, some 500 million years ago. The first fossils of plants and animals are found in rocks from the Cambrian period, around 540 million years ago. These early fossils are very small and simple, consisting mainly of tiny organisms like algae and bacteria. As time went on, larger and more complex organisms evolved, such as trilobites and brachiopods, which were followed by fish and then mammals and birds. The first mammals appeared around 200 million years ago, during the Triassic period. They were small and primitive, but over time they evolved into larger and more advanced forms, eventually leading to the modern mammals we know today. The first birds also appeared during the Triassic period, around 140 million years ago. They were small and primitive, but over time they evolved into larger and more advanced forms, eventually leading to the modern birds we know today. The first flowering plants appeared around 140 million years ago, during the Cretaceous period. They were small and primitive, but over time they evolved into larger and more advanced forms, eventually leading to the modern flowering plants we know today. The first mammals appeared around 200 million years ago, during the Triassic period. They were small and primitive, but over time they evolved into larger and more advanced forms, eventually leading to the modern mammals we know today. The first birds also appeared during the Triassic period, around 140 million years ago. They were small and primitive, but over time they evolved into larger and more advanced forms, eventually leading to the modern birds we know today. The first flowering plants appeared around 140 million years ago, during the Cretaceous period. They were small and primitive, but over time they evolved into larger and more advanced forms, eventually leading to the modern flowering plants we know today.

(2) The types are applicable only to winter seasons.

(3) Types A and B are characteristic of a high partial zonal index, Type C, of a low index, and Types D₁, D₂, E, and F, of a moderate index.

(4) The partial zonal index from 60° West to 120° West and that from 60° West to 180° West have a correlation factor of .820, and an independent correlation of .135. It is possible to estimate one index from the other with commensurate accuracy.

(5) The weather types are less well defined in winters of relatively low average partial zonal index.

menten der Völker und Nationalen ein wenig auf. 17)

„... und so ist es mit dem kleinen Kind.“

„... wir haben uns sehr darüber freuen.“ 18)

„... wir haben sehr viel Freude daran.“ 19)

„... wir haben sehr viel Freude daran.“ 20)

„... wir haben sehr viel Freude daran.“ 21)

„... wir haben sehr viel Freude daran.“ 22)

„... wir haben sehr viel Freude daran.“ 23)

„... wir haben sehr viel Freude daran.“ 24)

„... wir haben sehr viel Freude daran.“ 25)

„... wir haben sehr viel Freude daran.“ 26)

„... wir haben sehr viel Freude daran.“ 27)

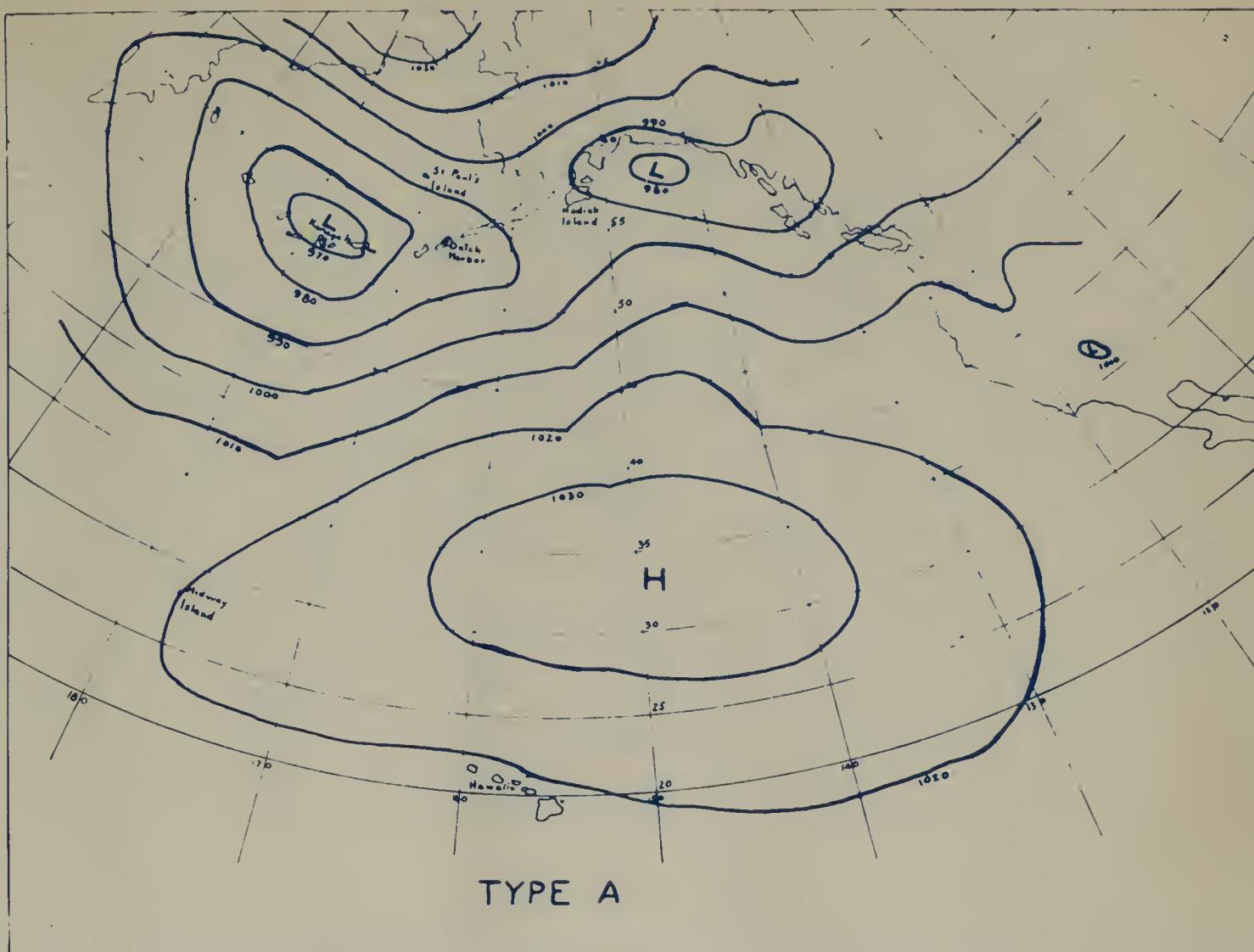
„... wir haben sehr viel Freude daran.“ 28)

„... wir haben sehr viel Freude daran.“ 29)

„... wir haben sehr viel Freude daran.“ 30)

(6) Individual winters show marked characteristics of period and amplitude in the partial zonal index curves, and these characteristics tend to persist unchanged throughout the season. Small amplitude is associated with short period, moderate amplitude with moderate period, and large amplitude with long period.

and would likely do nothing to mitigate
such an approach. Long latitudes and
increasing elevation tend to cause more intense
precipitation (Llopis et al., 2002). This would
estimate a higher trend for precipitation
models than a study with more limited data
and a shorter time period, due to changes
in atmospheric circulation patterns.
However, the results of this study, as
well as previous work, indicate that
the projected increase in precipitation
will be less than the projected increase
in temperature, which will result in
less snow accumulation over the
century. The projected decrease in
snow accumulation will likely result in
increased runoff and decreased soil
moisture, which will further reduce
snow accumulation. This feedback loop
will likely result in a significant
decrease in snow accumulation over
the century.



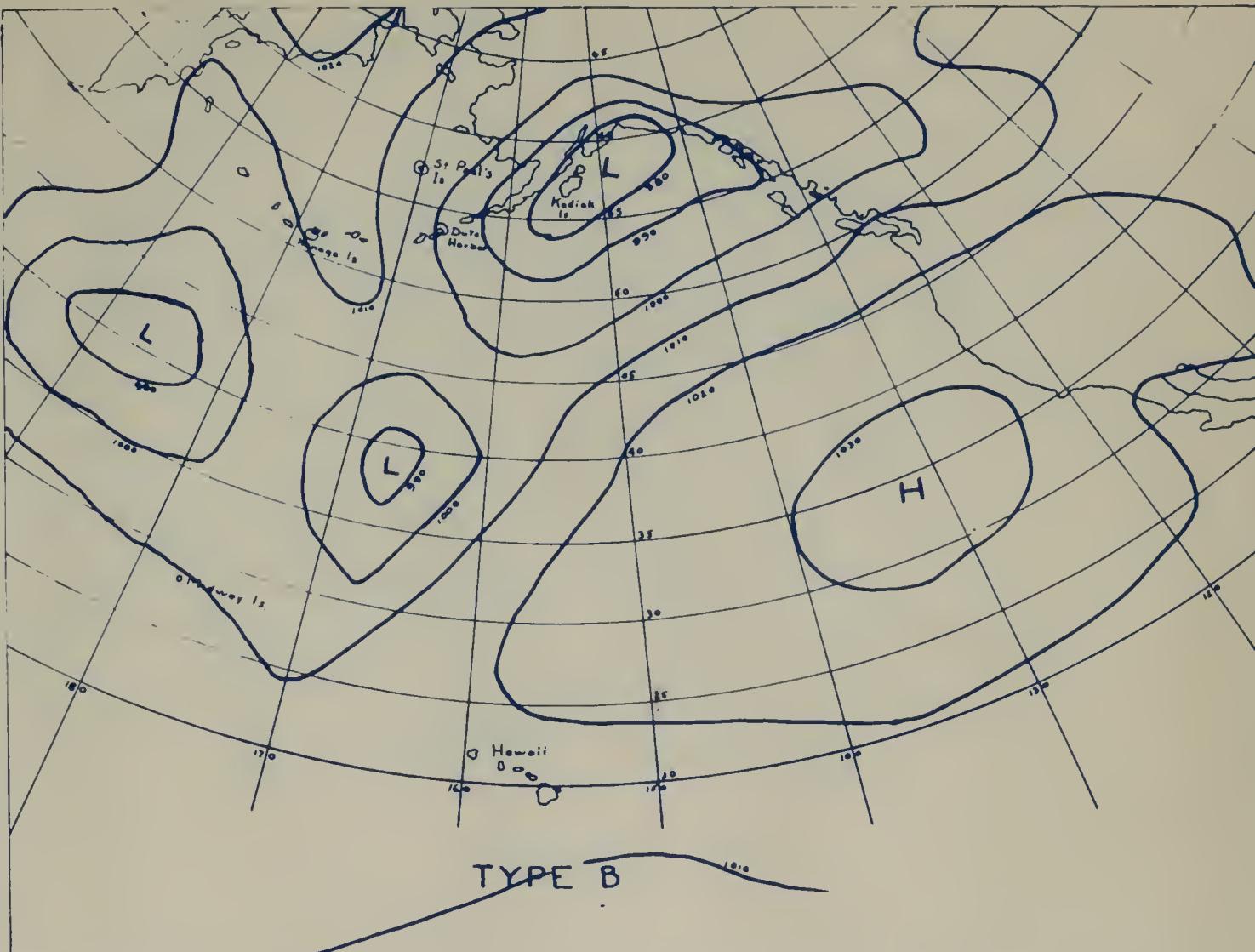
GENERAL FEATURES

The Pacific subtropical high is extensive, with the major axis lying east-west. Cyclones move rapidly along the Aleutian Islands to the Canadian Coast. Occasionally this type may have a weak and dissolving frontal system running through the middle of the area.

INDICATIONS

Type "A" will be recognized by stable conditions and high pressure at Midway, Hawaii and along the California Coast. The Aleutian and southern Alaskan Coasts and the Canadian Northwest Coast will be the scene of a chain of rapidly moving cyclones, occluding usually in the Gulf of Alaska, and disintegrating along the western mountain ranges. This type is characterized by the highest Continental-Pacific index of all types (mean value for 3 winters, 14.0 millibars).

PLATE NO. III

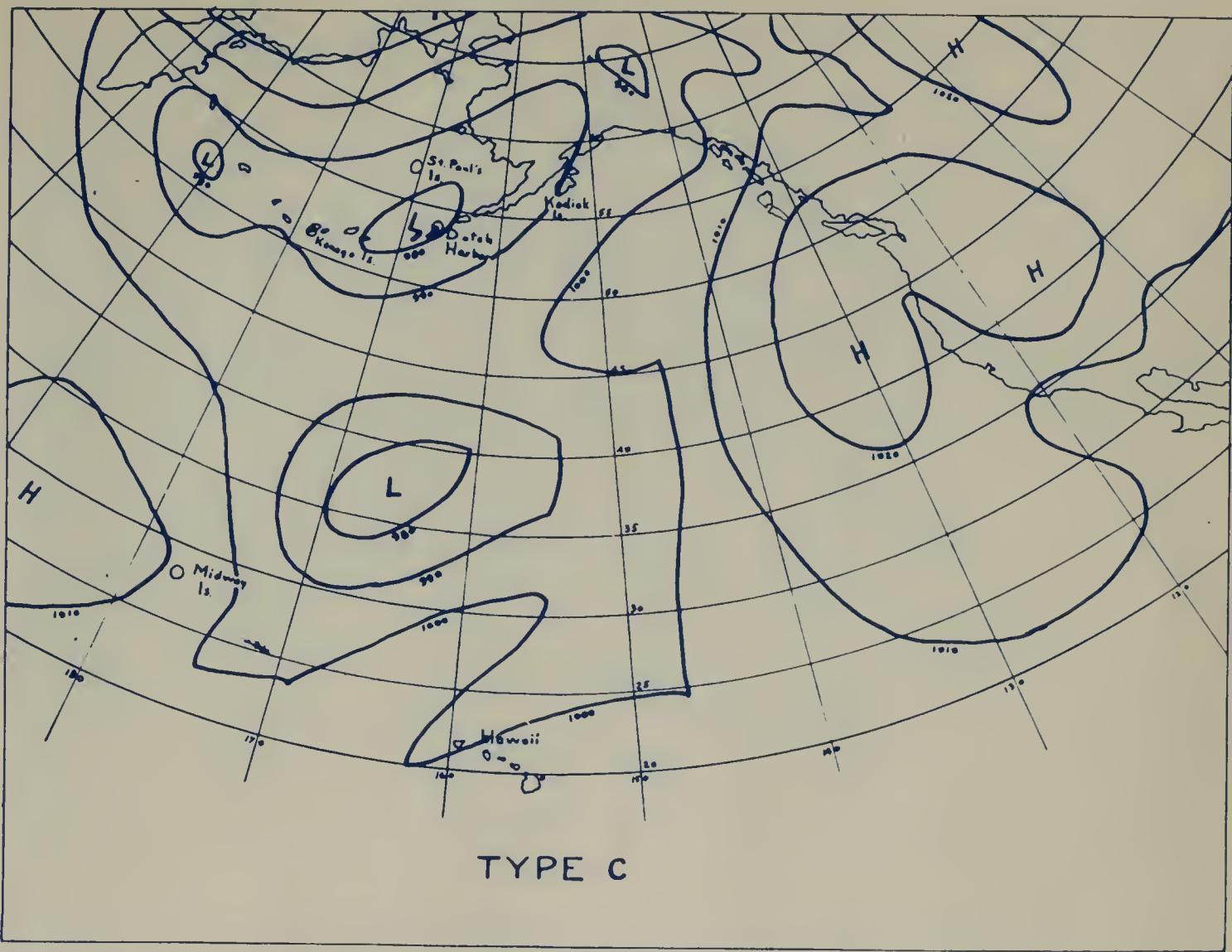
GENERAL FEATURES

The Pacific subtropical high is extensive, with the major axis lying northeast-southwest. Cyclones move from the vicinity of Midway or slightly north of that island toward the northeast to the continent, finally dying out along the mountain ranges.

INDICATIONS

Type "B" will be recognized by relatively high pressure extending to more northerly latitudes than in type "A" and steady or rising tendencies along the coast of the United States, low pressure along the Aleutian Chain extending into the Gulf of Alaska, high pressure at Hawaii, and a low pressure trough at Midway. The upper winds along the coast of British Columbia and northwestern United States will be strong steady westerlies. [This type is characterized by a high Continental-Pacific index (mean value for 3 winters 13.4 millibars).]

PLATE NO. IV



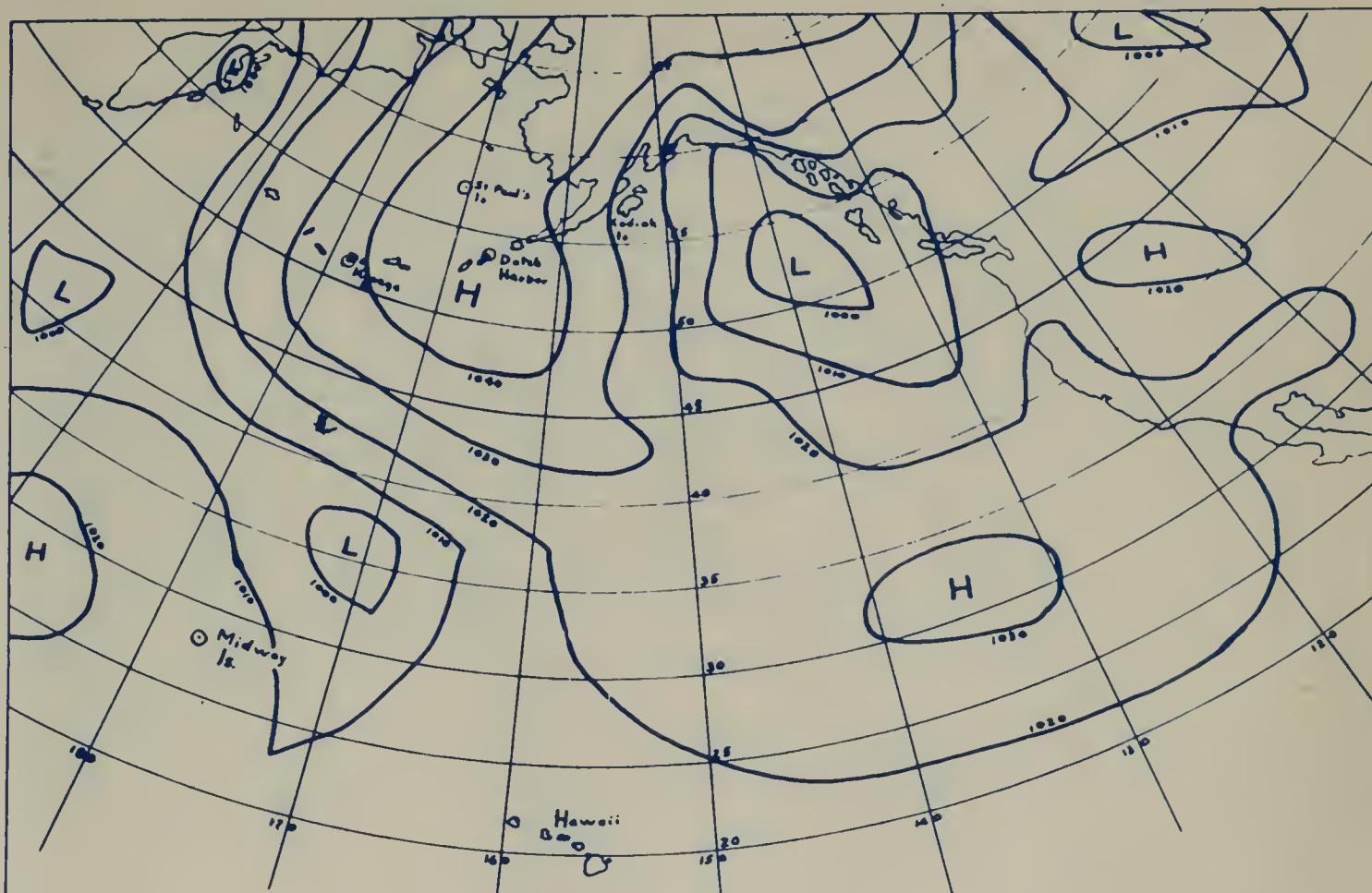
GENERAL FEATURES

The Pacific subtropical high lies in the eastern part of the Pacific along the west coast of the continent with a north-south axis. A trough of low pressure extends northward from Hawaii all the way into the Bering Sea. A large part of the Central North Pacific Ocean is, therefore, under the influence of low pressure.

INDICATIONS

Type "C" will be recognized by relatively high pressure along the coast of the United States and British Columbia, low pressure along the Aleutian Chain extending into the Gulf of Alaska, low pressure at Midway and low pressure at Hawaii. There will be a change from the prevailing easterly winds, at Hawaii, to southerly or southwesterly winds. [This type is characterized by having the lowest Continental-Pacific index of all types (mean value for 3 winters 3.6 millibars).]

PLATE NO. V



TYPE D.

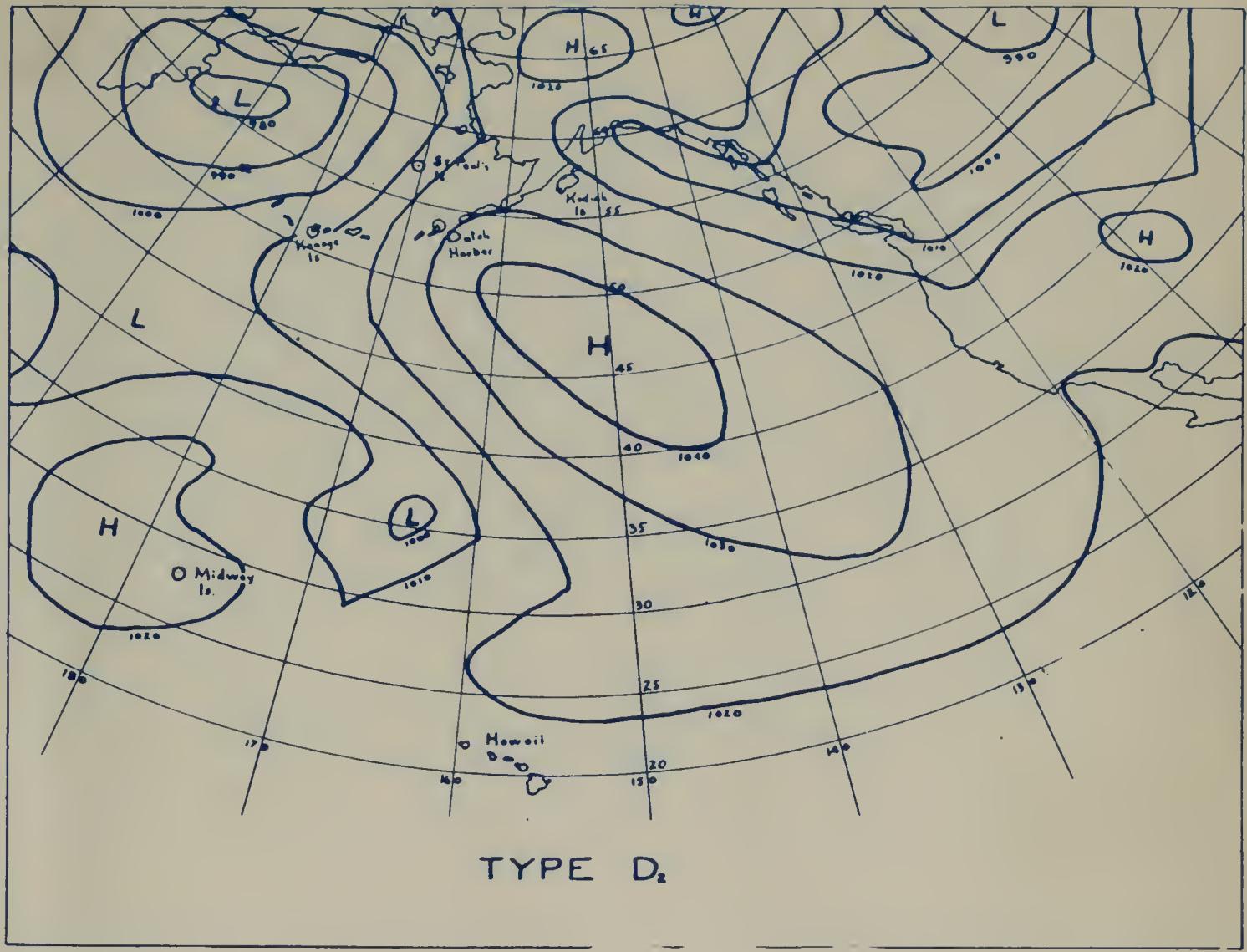
GENERAL FEATURES

The axis of the Pacific subtropical high is North-west-southeast. There is a deepening low in the northern part of the area and the circulation is causing a reinforcement of the Pacific High by the advection of Polar Continental or Polar Pacific air.

INDICATIONS

Type "D₁" will be recognized by high pressure with steady or rising tendencies in the Aleutian Islands if reinforcement is with Polar Continental air; a deep occluded low in the northern part of the area, high pressure along the California Coast with steady or rising tendencies, and low pressure in the Midway-Hawaii area. If reinforcement is from Polar Pacific air the location of reinforcement is not discernible from mainland or island indications. This type is characterized by a moderate Continental-Pacific index (mean value for 3 winters 8.7 millibars).

PLATE NO. VI



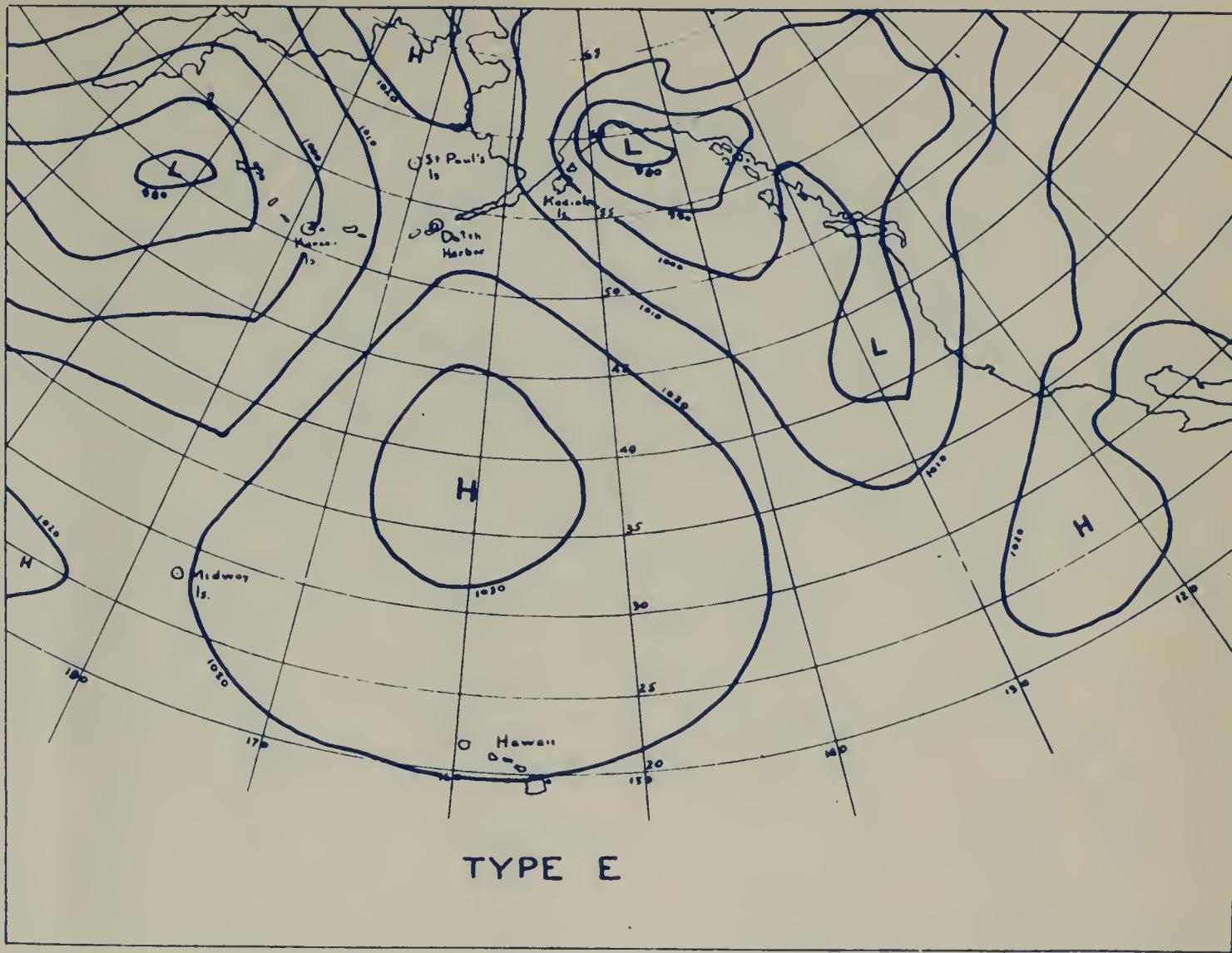
GENERAL FEATURES

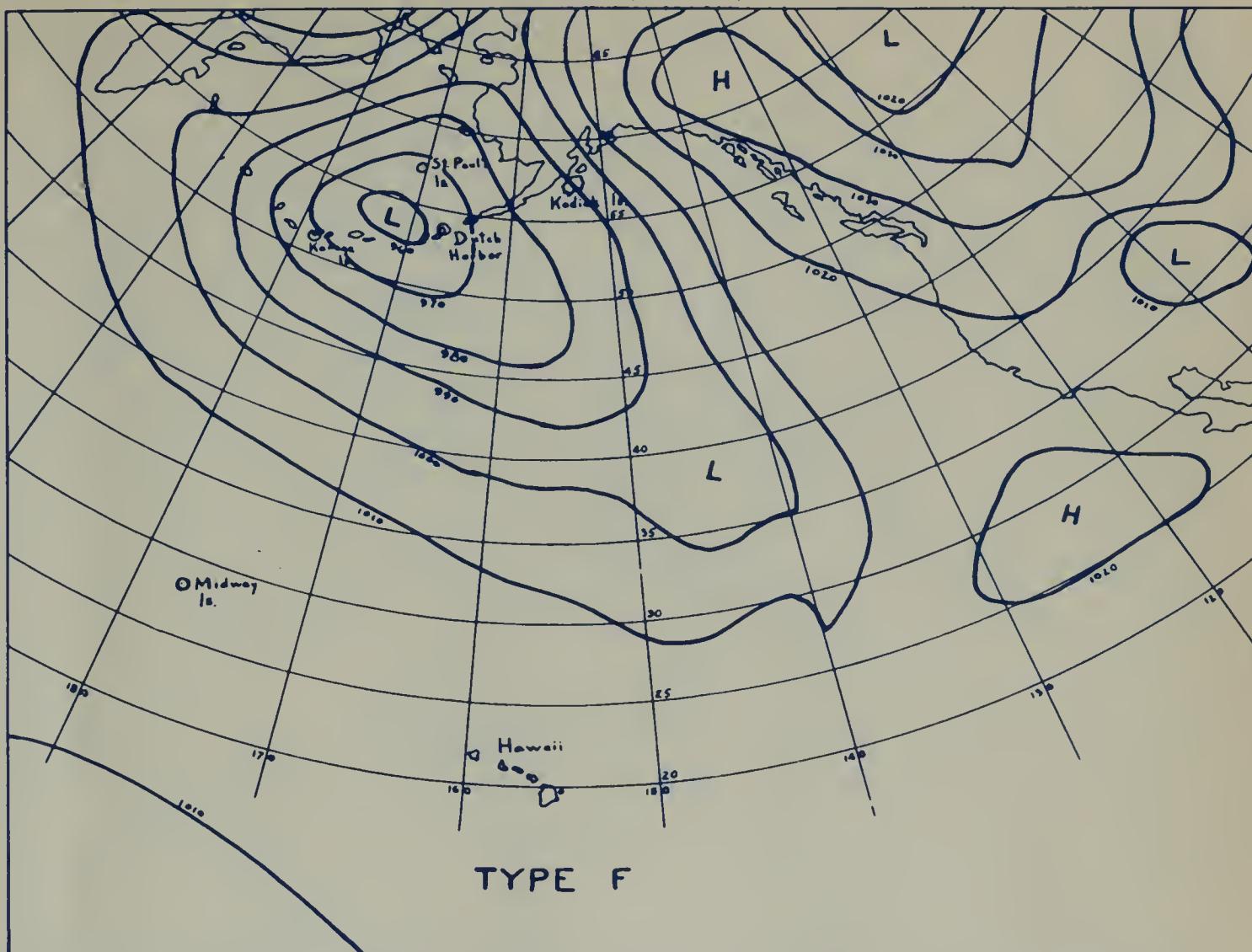
This type usually follows from type "D₁" and is of short duration. The axis of the Pacific High is northwest-southeast and a chain of lows moves southeast along the North American Coast.

INDICATIONS

Northwest winds and high pressures prevail over most of the coast of North America. A high pressure exists along the eastern Aleutian Islands and the Alaskan Peninsula with, usually, falling tendencies. This type is characterized by a moderate Continental-Pacific index (mean value for 3 winters 8.4 millibars).

PLATE NO. VII





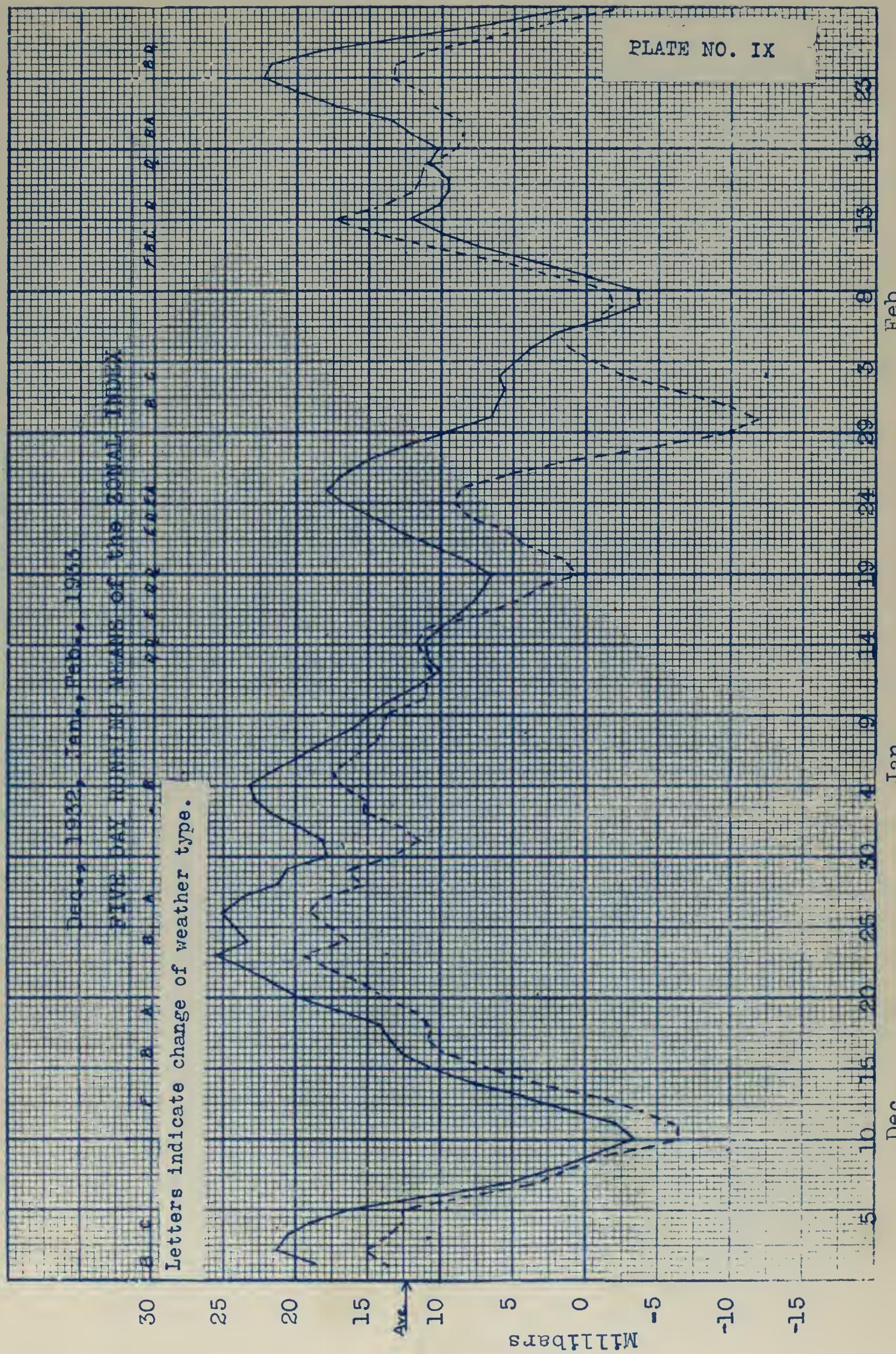
GENERAL FEATURES

Practically no Pacific subtropical high exists, or else the high has been displaced far to the South leaving nearly all of the area under cyclonic circulation. The Aleutian Low is near its maximum development.

INDICATIONS

Southerly winds prevail along the California Coast and westerly winds in the Midway-Hawaii area. Both of these areas are subject to generally bad conditions involving frontal influences. The low center lies either over the Aleutian Area or well to the south. This type is characterized by a moderate Continental-Pacific index (mean value for 3 winters 6.5 millibars).

PLATE NO. IX



Feb

Jan.

Dec.

(60-180 degrees west)

(60=120 degrees West)

PLATE NO. X

Janes, Barb., Mar., 1939.

FIVE DAY MEAN PRESSURE INDEXES OF THE ZONAL INDEX

30

Letters indicate change of weather type.

25
20
15
10
5
0
-5
-10
-15

MILLIBARS
Av. 10

Jan. Feb. Mar.
— (60-180 degrees west)
--- (60-120 degrees west)

Nov., Jan., 1940 Jan., Feb., 1941

THE JOURNAL OF CLIMATE

Letters indicate change of weather type.

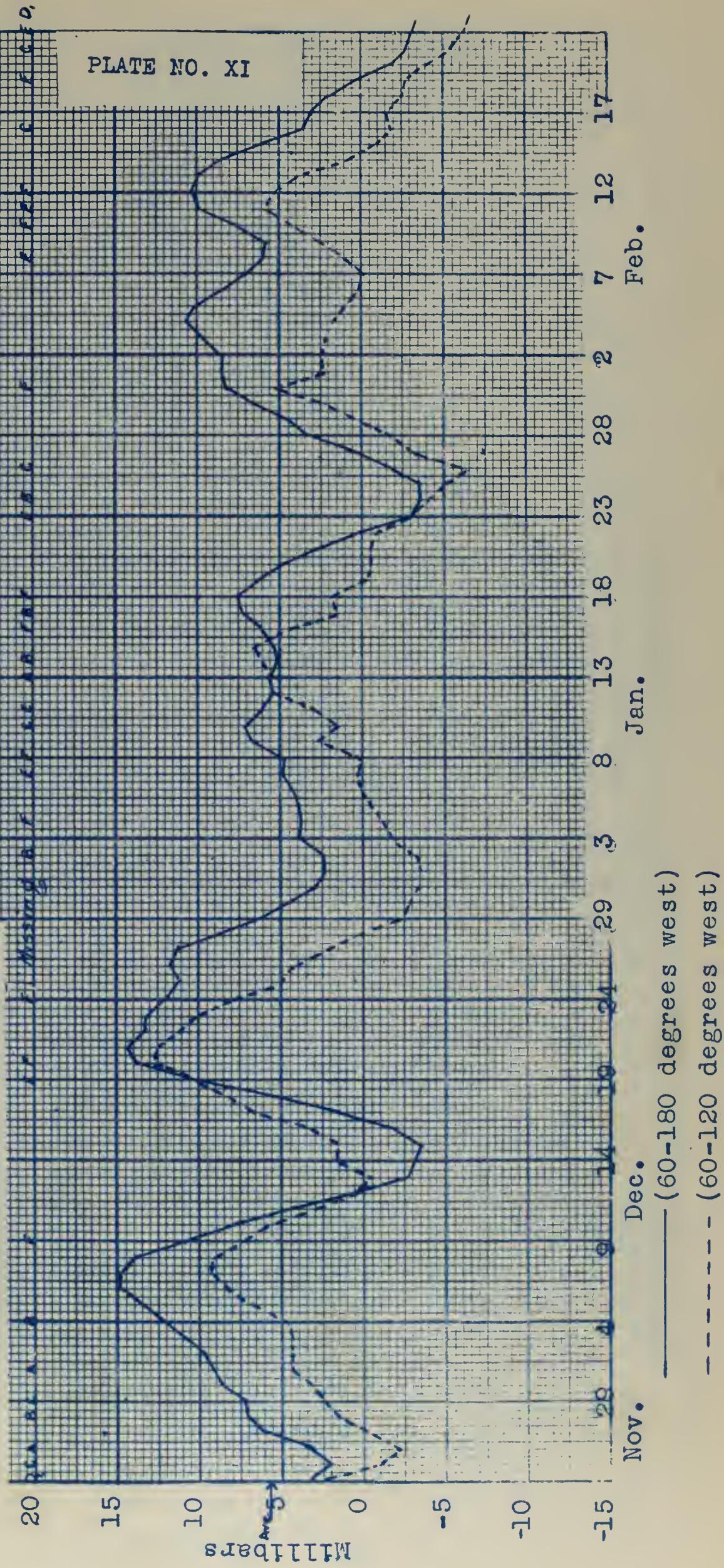
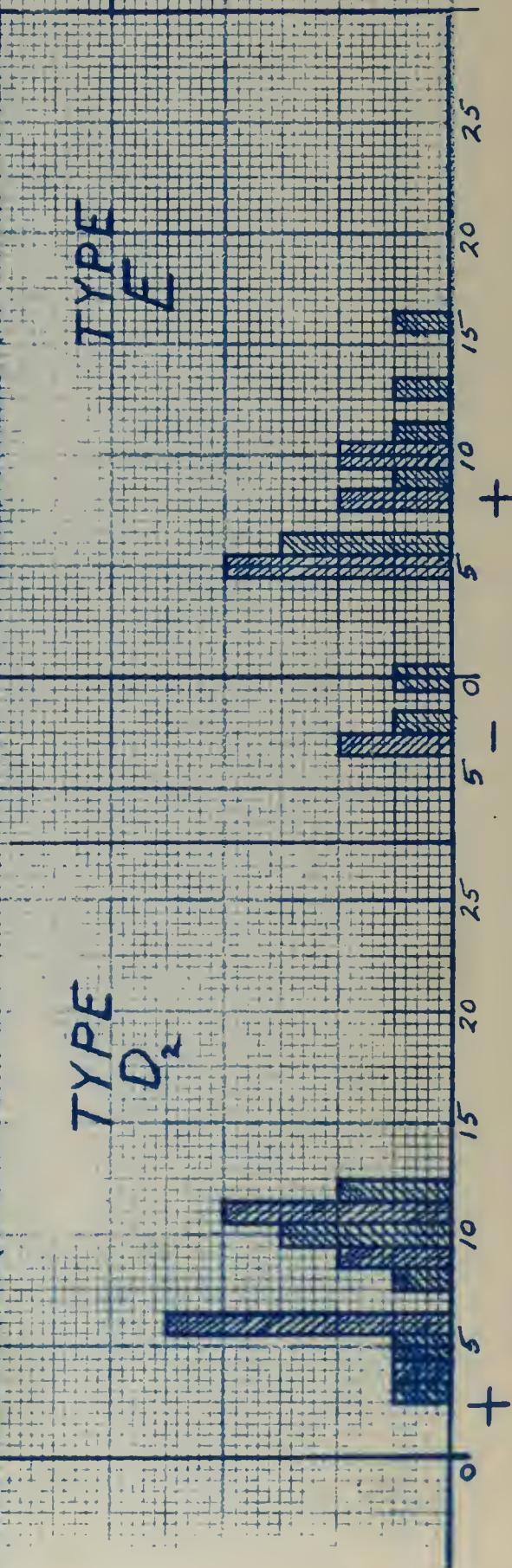
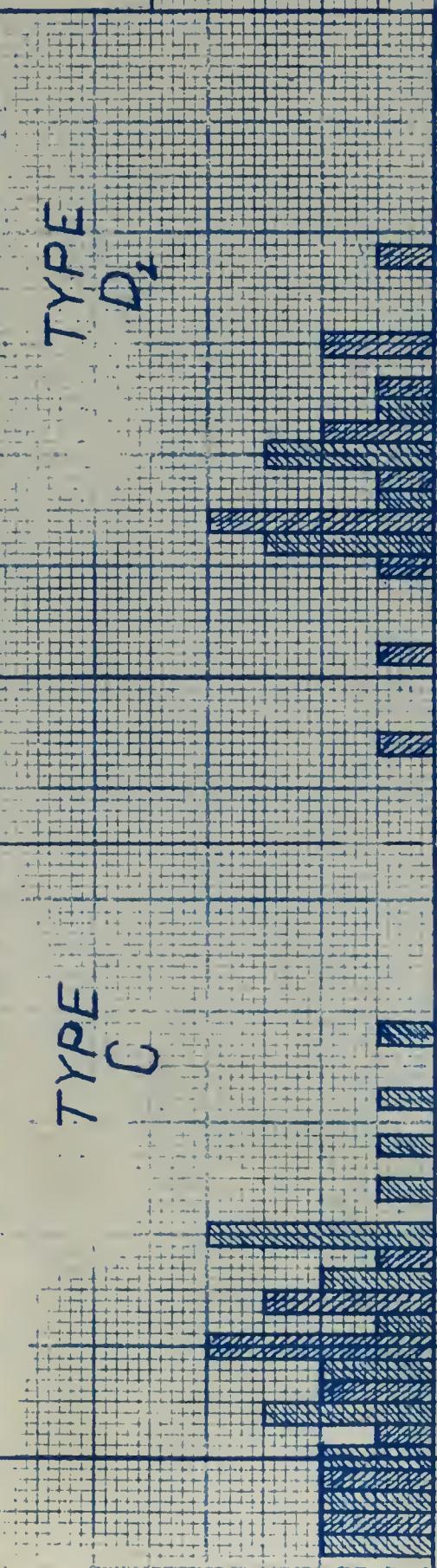
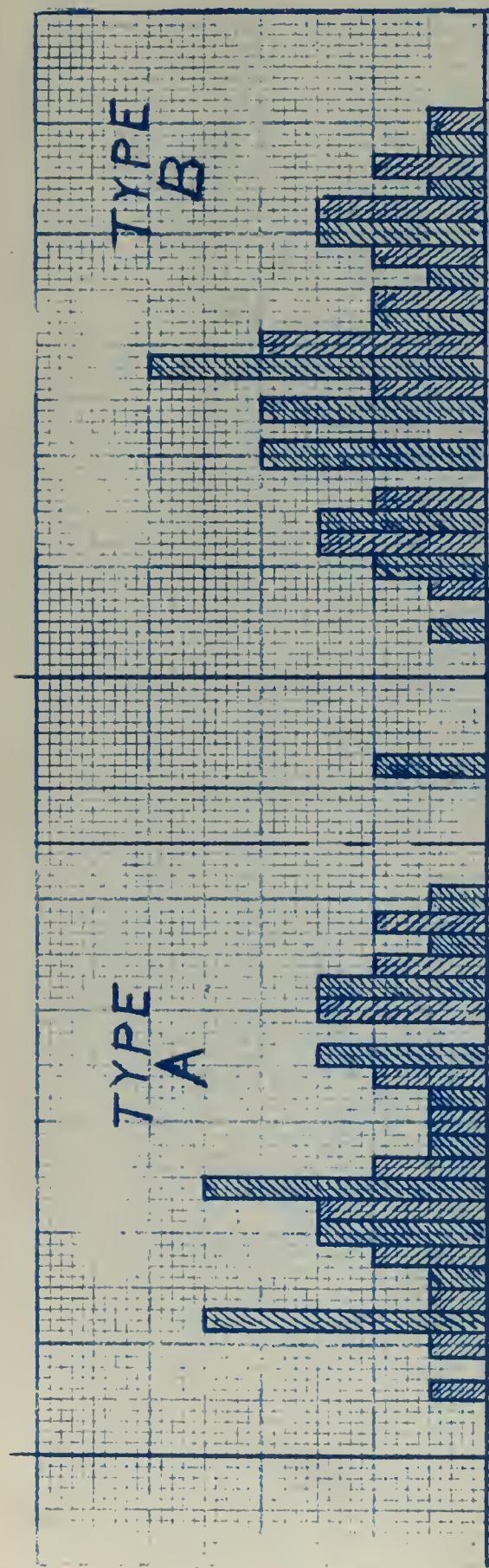


PLATE NO. XII

FREQUENCY OF ZONAL
INDEX VALUES FOR EACH
WEATHER TYPE.



Zonal Index (millibars)

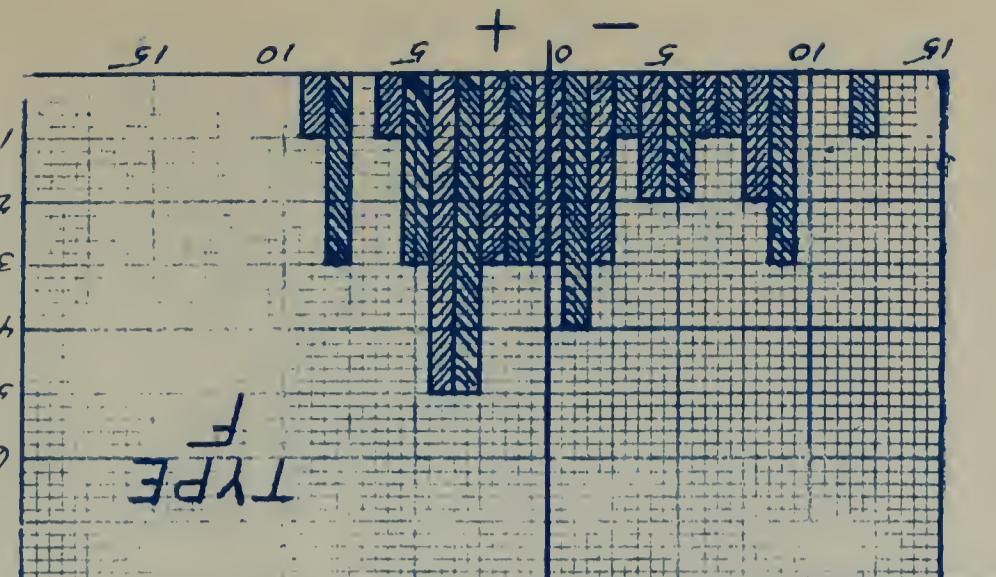
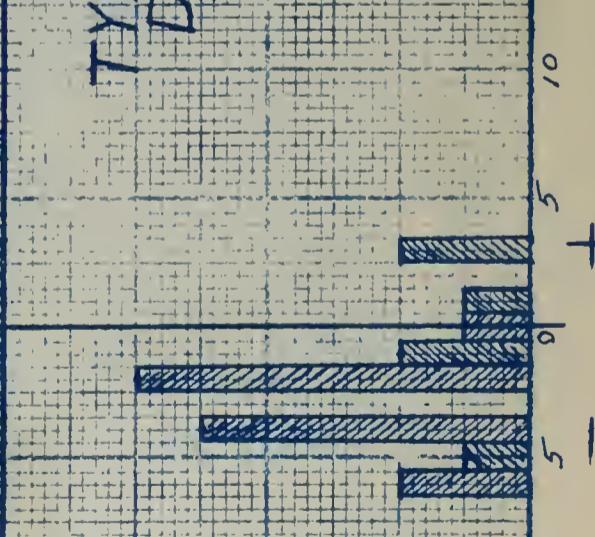
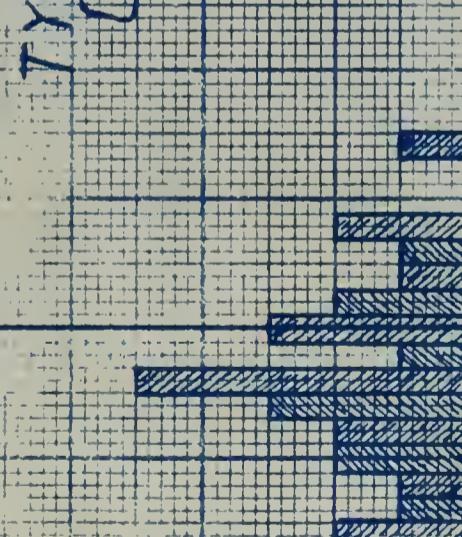
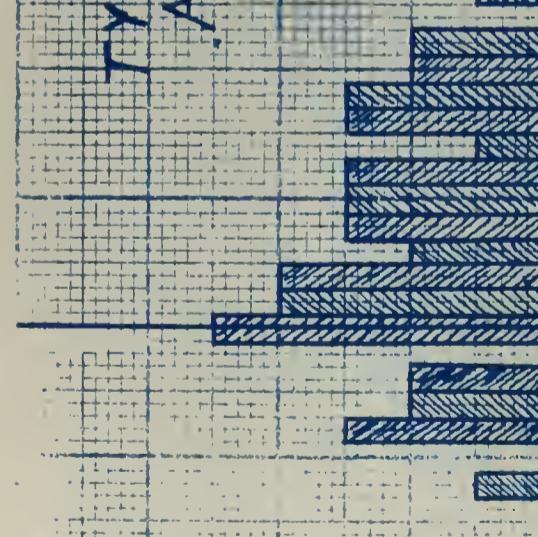
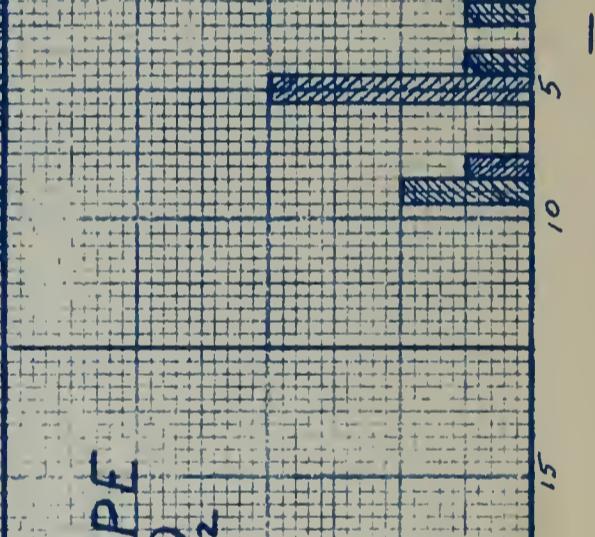
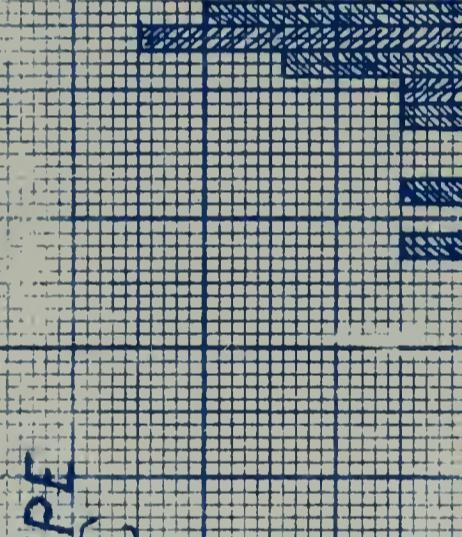
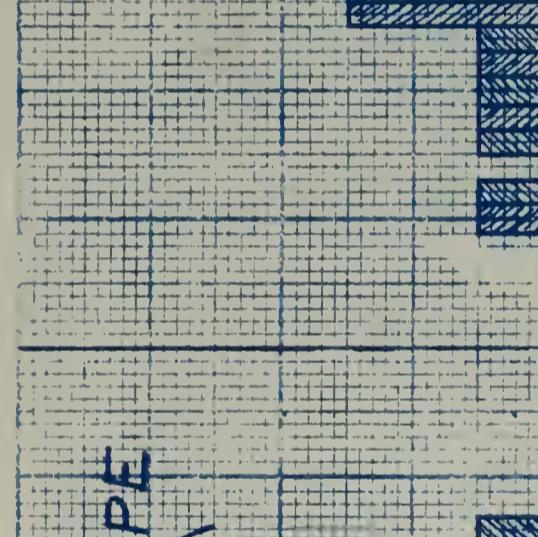
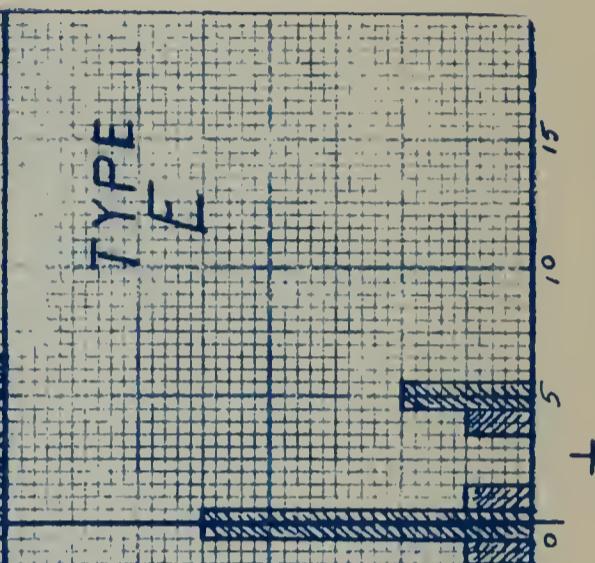
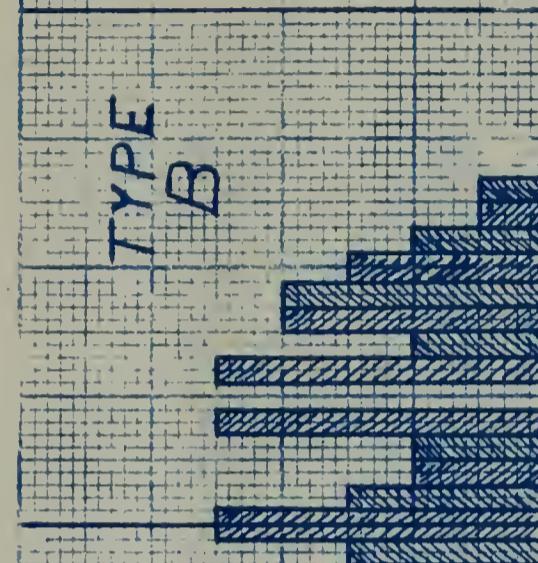


PLATE NO. XIII

FREQUENCY OF DEPARTURE
OF ZONAL INDEX FROM
ITS OWN WINTER MEAN.



6 5 4 3 2 1

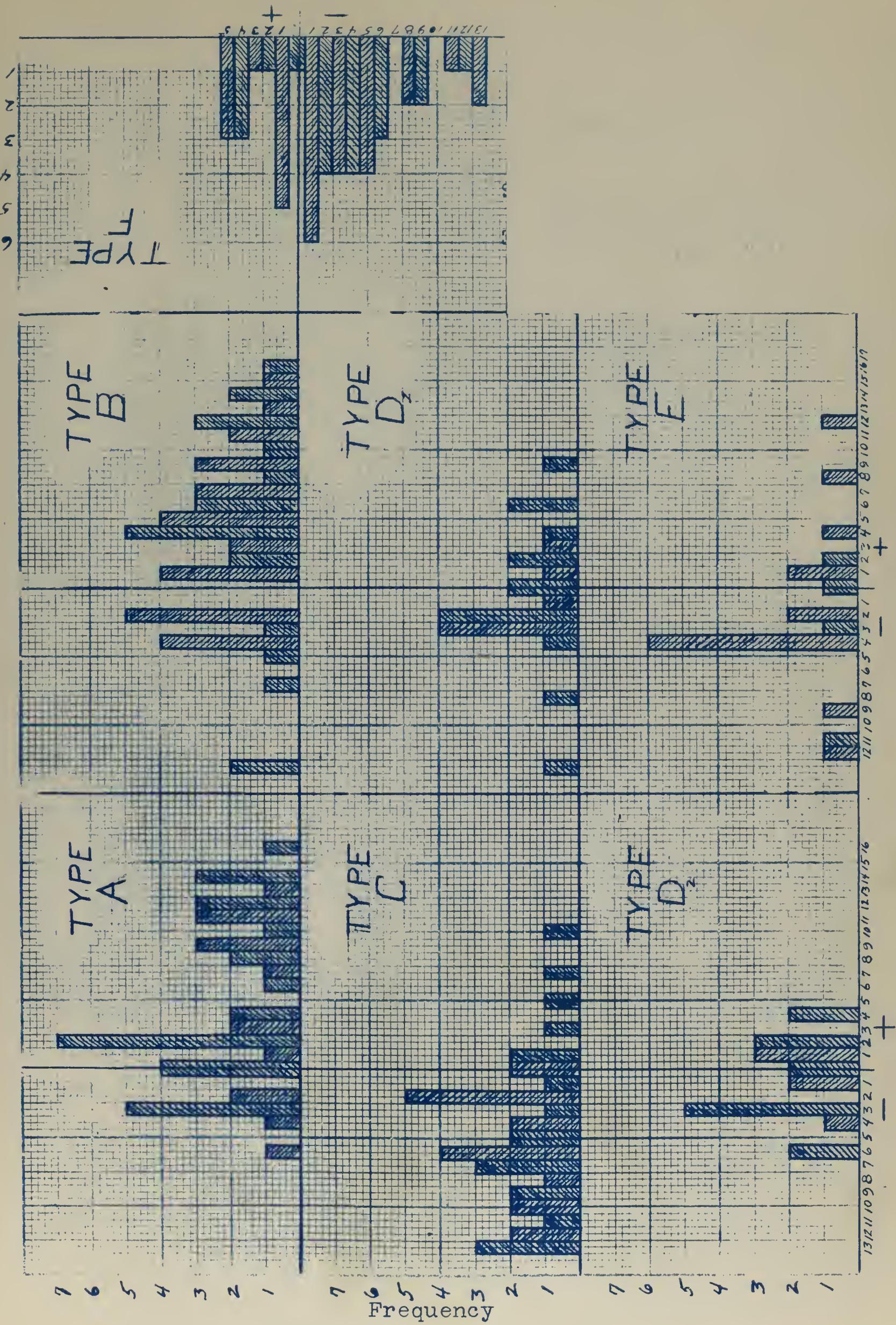
6 5 4 3 2 1

6 5 4 3 2 1

Frequency

Departure of Zonal Index from Mean (millibars)

Departure of Zonal Index from Mean (millibars)



Thesis

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Identification of winter
weather types of the
eastern north pacific by
means of a partial zonal
index.

Thesis

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Identification of winter
weather types of the eastern
north pacific by means of a
partial zonal index.

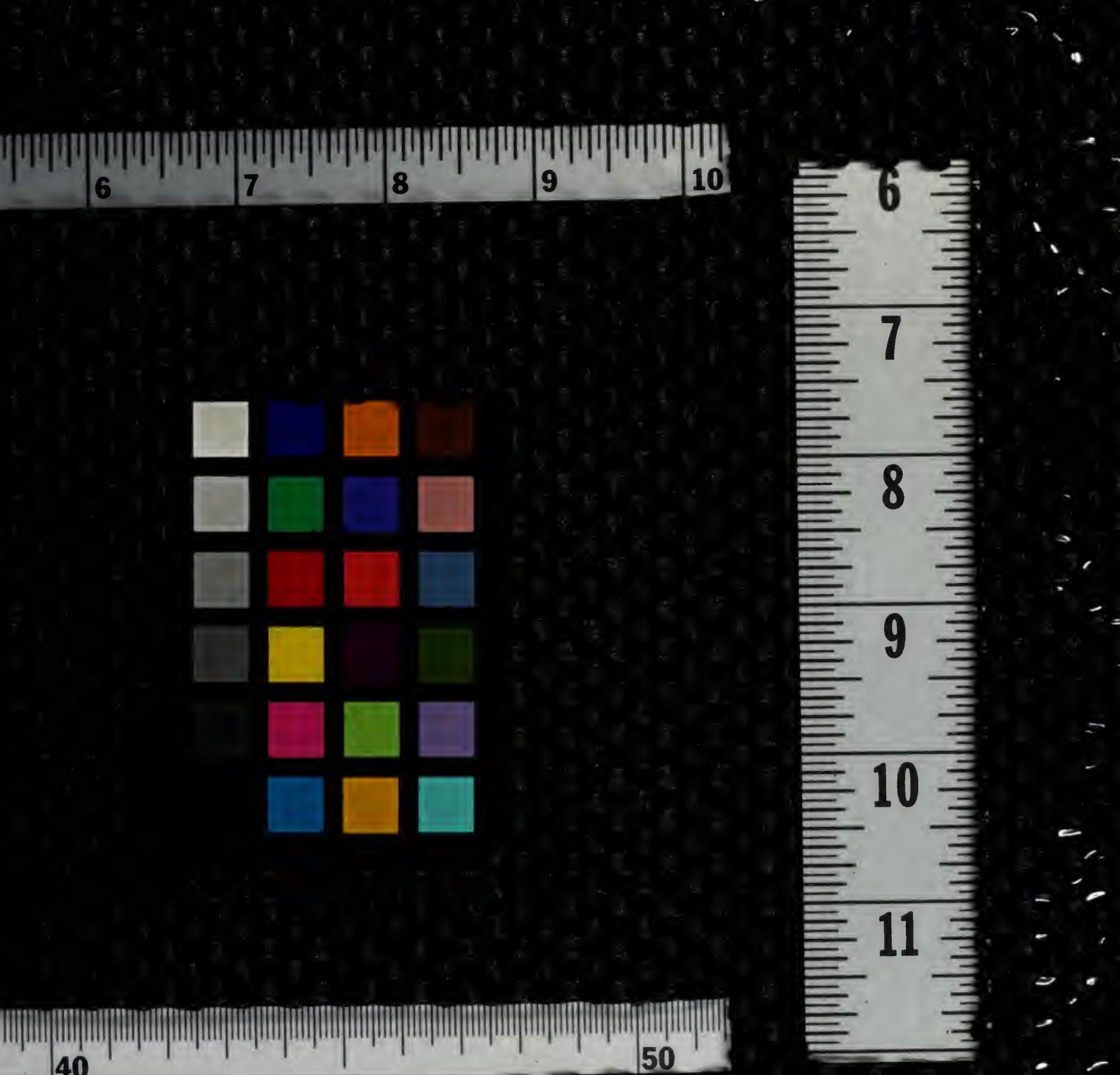
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Identification of winter weather types o



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